SANDAKANIA 21 (2016): 65–130

Studies in Malesian Gentianaceae, VII. A revision of *Fagraea* in the Malay Peninsula with five new species

K.M. Wong[1] and M. Sugumaran[2]

[1] Singapore Botanic Gardens, National Parks Board,
1 Cluny Road, Singapore 259569.
wkm2000@gmail.com

[2] Rimba Ilmu Botanic Garden,
Institute of Biological Sciences, University of Malaya,
50603 Kuala Lumpur, Malaysia.
maran@um.edu.my

Summary. *Fagraea* Thunb., as distinguished from various taxa now moved to the genera *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*, is revised for the Malay Peninsula. A review of useful characters and morphological variation is provided. Out of 18 species enumerated, five are new and provided with descriptions and illustrations: *Fagraea cameronensis* K.M.Wong & M.Sugumaran, *F. fraserensis* K.M.Wong & M.Sugumaran, *F. kinghamii* K.M.Wong & M.Sugumaran, *F. larutensis* M.Sugumaran, and *F. latibracteata* M.Sugumaran. *Fagraea calcarea* M.R.Hend. is placed under *F. curtisii* King & Gamble as a newly recombined variety.

A study of the highly polymorphic *Fagraea* complex using both morphological and molecular approaches has shown that the group is represented by five distinct genera (Sugumaran & Wong 2012, Wong & Sugumaran 2012a). Of these, *Limahlania* K.M.Wong & M.Sugumaran is a monotypic genus (Wong & Sugumaran 2012a), *Cyrtophyllum* Reinwardt and *Picrophloeus* Blume have been revised (Wong & Sugumaran 2012b, Wong 2012), and *Utania* Don has been revised for the Malay Peninsula (Sugumaran & Wong 2014). The present contribution is a revision of the Malay Peninsula species of *Fagraea* Thunb., a genus distributed from Sri Lanka and India, through tropical South East Asia, reaching east to Polynesia (Struwe et al. 2002).

Early accounts since those by Wallich in Roxburgh (1824) and Clark (1883) in Hooker's *Flora of British India* have included representatives of the different genera mentioned above.

In terms of *Fagraea* in the strict sense as the present revision addresses, Clark (1883) listed only *F. auriculata* Jack and *F. obovata* Wall. Later, six species of *Fagraea* s.s. were listed by King & Gamble (1904), whereas Ridley (1923) recorded an impressive 11 species. This represented a 5-fold increase of species enumerated in a 40-year period between Clarke (1883) and Ridley (1923), during a time of active botanical exploration and documentation.

Wong & Sugau (1996) have drawn attention to the difficulty of using the generally broad species concepts adopted by Leenhouts (1962), which they consider in many cases to be artificial assemblages of distinct species. They provided some striking examples to support their argument. For instance, they explained that Leenhouts' concept of *Fagraea ceilanica* included specimens from the type provenance (Sri Lanka) with 8–9-cm-long corolla tubes as well as specimens with corolla tubes not more than 3 cm long (from India and Malesia), without any intermediate forms. Wong & Sugau (1996), working primarily on Borneo, also treated six taxa of *Fagraea* s.s. that were relevant to the Malay Peninsula, resurrecting two names (*F. oblonga* King & Gamble, *F. splendens* Blume) and diagnosed another species previously confused with others (*F. renae* K.M.Wong & Sugau). The present account enumerates 18 species, including five new species and relegates *Fagraea calcarea* M.R.Hend. to a newly combined variety of *F. curtisii* King & Gamble.

MORPHOLOGY

Several important characters that help set apart *Fagraea* from the other genera of the complex include the smooth to lightly scaly-dippled stem bark (in contrast to fissured bark), a fresh fruit pericarp that produces copious amounts of pale creamy to yellowish latex (instead of small amounts of translucent or gummy latex, or none at all) and an ellipsoid-rounded (rather than polygonal) seed shape (Sugumaran & Wong 2012, Wong & Sugumaran 2012a).

Growth habit and architecture

Species of *Fagraea* have growth habits ranging from free-standing trees, erect or scrambling shrubs, to climbers, epiphytes, and hemi-epiphytes (Fig. 1 & 2). The term "hemi-epiphyte" has come to refer to initially terrestrial plants, such as some aroids (Araceae), with stems that creep up tree trunks and then lose connection with the ground through breakage or decomposition of the proximal parts, as well as to the growth habits of "strangling" figs (*Ficus* spp., Moraceae) (Putz & Holbrook 1989). In the latter case, the fig plants begin life newly germinated on a tree branch, as an epiphyte, and then develop roots that encircle the supporting trunk and at the same time growing down into the forest floor (Corner 1988). As a number of *Fagraea* species have growth habits similar to strangling figs, here the term "hemi-epiphyte" is likewise adopted to refer to their growth habit. In some cases noted for the so-called strangling figs, the "host" tree eventually dies because the fig develops a crown of its own that shades out that of the host and its anastomosing root-lattice prevents further

Fig. 1. Growth habits of *Fagraea* species. **A.** *Fagraea splendens*, climbing. **B.** *Fagraea splendens* developing multiple shoots from stems growing over a rock. **C.** *Fagraea imperialis* with a thick stem and adventitious roots binding around its support tree (*Sugumaran et al*. SM 230). **D.** *Fagraea gardenioides* sapling establishing on a mossy tree trunk in upper montane forest. (Photo credits: A, Ang Wee Foong; B & D, K.M. Wong; C. M. Sugumaran)

Fig. 2. Growth habits and cultivation of *Fagraea* species. **A.** Erect tree-shrubby habit of *Fagraea auriculata* at Menchali Forest Reserve, Pahang, with Zulkapli Ibrahim. **B.** Planted *Fagraea auriculata* at Singapore's Hort Park. **C.** *Fagraea auriculata* in a pot in open garden landscaping, Rimba Ilmu Botanic Garden, University of Malaya. **D.** *Fagraea splendens* established in a Singapore garden setting. (Photo credits: A & C, K.M. Wong; B & D, Ang Wee Foong)

host thickening. The same effect has been implied for the hemi-epiphytic *Fagraea imperialis* Miq., which Ridley (1930) says, "begins life as an epiphyte on a Palm or other tree, and, eventually killing its host, descends to the ground and forms a widely-spreading shrub or a tree..." Some other species are scramblers that form untidy tangles and twines, on small trees or on rocky surfaces (e.g., *F. carnosa* Jack).

We have also noticed root suckers forming in *Fagraea auriculata* plants in the sandy substrates of the Menchali Forest Reserve in Pahang, Malaysia. Generally, in plants with a growth habit varying from a shrub or free-standing tree to a hemi-epiphyte, the branches or roots may easily sprout new shoots as well as root. The work reported by Yeo et al. (2011) confirms the relative ease of air-layering for propagation of this species. In view of the big beautiful blooms, attractive leathery foliage and tidy plant form, as well as ease of propagation, we expect this species, as well as others like *Fagraea splendens*, to become more popular as potential garden and landscaping species in the future (Fig. 2). The plants do very well in open sites and thus have much potential in tropical urban settings.

All *Fagraea* s.s. species studied conform to the growth architectural model of Scarrone, in common with *Picrophloeus* but distinct from *Cyrtophyllum* (Aubreville's model), *Limahlania* (Fagerlind's model) or *Utania* (Roux's model) (Hallé et al. 1978, Sugumaran & Wong 2012).

Leaves

Generally, the species known so far have leaf sizes ranging from several cm to over 20 cm long. Within this range, a number of species characteristically have leaves within the upper part of the range (such as *Fagraea auriculata*, *F. imperialis*, *F. ridleyi* King & Gamble). Typically, *Fagraea* leaves are thick-coriaceous.

Leenhouts (1962) recorded that a few species of *Fagraea* have ant-associations, with ants attracted to extra-floral nectaries at the base of the leaves, on the leaf lamina (a drawing of *F. ridleyi* as Fig. 16 in his work illustrates this; see also Fig. 3A) and on the calyces (Fig. 3 C & D). He also stated that the conspicuously developed leaf-base auricles of a few *Fagraea* species housed ants underneath (Fig. 3B). Elias (1983) lists *Fagraea* under the "hollow nectaries" group among the six extra-floral nectary groups he recognised, based on a classification of Angiosperm extra-floral nectaries by Zimmerman (1932).

Petiole-base appendages

The structures at the petiole base in *Fagraea* species have been discussed by Leenhouts (1962), who considered the cup-like or sheathing structure as a kind of "*vaginae connatae*" (fusion of sheaths) between the petioles of a leaf pair, as typically expressed in the New Guinean *Fagraea salticola* Leenh., or the Malayan *F. gardenioides* Ridl. (Fig. 4), where two "axillary scales" meet but are not conspicuously joined along the interpetiolar median. These structures

Fig. 3. *Fagraea* and ants. **A.** Conspicuous pale dot-glands (extra-floral nectaries) in *Fagraea carnosa* leaves (*Sugumaran & Lee* SM 186). **B.** Ant-cartons built around the leaf stalk auricles of *Fagraea auriculata*. **C.** Ants on the calyces of floral buds in *Fagraea auriculata* (*Sugumaran* SM 25). **D.** Ants on calyces of *Fagraea splendens*. (Photo credits: A & C, M. Sugumaran; B, K.M. Wong; D, Ang Wee Foong)

were accepted as stipules by Leenhouts (1962). Struwe et al. (2002) consider stipules to be absent in the Gentianaceae (including *Fagraea*) but that interpetiolar lines or sheaths are conspicuous in many cases. They noted that low, interpetiolar sheaths between leaf bases or around stems can be found in several genera. The term "stipule" was also not favoured by Wong & Sugau (1996), who simply described the petiole bases as basally elaborated with axillary scales. They observed that, among the entire *Fagraea* taxonomic complex, the axillary scales form just above the petiole base and only loosely clasp the node in *Fagraea* s.s. and another taxon later placed in *Limahlania*. In the present account we adopt the term petiolar sheath as Struwe et al. (2002) have used. In contrast, what we now know as *Cyrtophyllum*, *Picrophloeus* and *Utania* have the petiolar sheaths fused at the node into a cup-like ochrea (Sugumaran & Wong 2012).

Fig. 4. Detail of apical shoot portion in *Fagraea gardenioides*, showing petiolar sheaths. (Photo: M. Sugumaran)

Leenhouts (1962) also discussed the taxonomic utility of auricles, which he considered as appendages to the base of the leaf blade, and distinct from the "stipules". He noted how auricles may be only slightly developed in some species, large in others, and reflexed or not. These auricles are very conspicuous in species such as *F. auriculata* and *F. imperialis* (Fig. 3B & 14). Struwe et al. (2002) also noted that among the tribe Potalieae, which includes *Fagraea*, auricles are not common although winged petioles are frequent both in that tribe and among gentians in general.

Inflorescence position and form

The position of the inflorescence is terminal, as in *Limahlania*, *Picrophloeus* and *Utania*. In comparison, *Cyrtophyllum* has axillary inflorescences. *Fagraea* s.s. has an inflorescence without branching (with just a single flower on a very condensed axis, where all branches are entirely suppressed), or which develops distinct primary branches that rebranch 1–3 times (Wong & Sugau 1996).

Leenhouts (1962) also used the character of "warty-lenticellate" inflorescence axes to separate *Fagraea blumei* G.Don in his key to species, but Wong & Sugau (1996) pointed

out that this interpretation included several distinct species throughout Southeast Asia. This character is not used by other workers.

Floral size, involucrate bracts, corolla, and stamens

Fagraea s.s. species have flowers ranging from small (corolla tubes under 2 cm long) to medium, to large (corolla tubes around 15 cm long) (Leenhouts 1962). Very large corollas are not found in *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*, where corollas are small to medium (just several cm long)

Leenhouts drew attention to some species where the floral bracts are enlarged, to an extent that they partly covered the calyx. Wong & Sugau (1996) described the structure formed by such enlarged bracts as an involucre. Such involucres are seen, for example, in the Malayan *Fagraea kinghamii* K.M.Wong & M.Sugumaran (Fig. 15) and the Bornean species, *F. involucrata* Merr. and *F. macroscypha* Baker.

Fagraea s.s. and *Limahlania* have stamens that are only slightly to medium-exsert, whereas *Cyrtophyllum* and *Picrophloeus* have long-exsert stamens. *Utania* has stamens that are included to medium-exsert (Sugumaran & Wong 2012). Leenhouts (1962) cites Burck (1892) for the observation that the flowers of species such as *F. auriculata* are protandrous. We have noticed the style and stigma remain fresh for a long time and the stigma probably becomes receptive after the male phase is over, when the filaments and anthers begin to wither (Fig. 5).

Ovary, styles and stigmas

Leenhouts (1962) and Kochummen (1973) described ovaries in *Fagraea* as either two-celled with axile placentation or one-celled with two parietal placentas. However, Leenhouts (1962) had remarked that although he could not conduct a thorough study with herbarium specimens, he had observed inconsistent placentation within a single taxon in one case, although he admitted that the single or few sections made for the few taxa surveyed may not be adequate for understanding this character properly. Wong & Sugau (1996) stated that in their observation of ovaries seen in many species of *Fagraea* across the three sections that now represent the five genera of the *Fagraea* complex, the ovaries were all unilocular with two parietal placentas. We have, however, also noted *Fagraea auriculata* fruits that are 2-celled with axile placentation (Fig. 6D).

Fagraea s.s. and *Limahlania* have styles that are not to slightly exsert, whereas *Cyrtophyllum* and *Picrophloeus* have long-exsert styles. *Utania* has styles not to slightly exsert (Sugumaran & Wong 2012). Sugumaran & Wong (2012) pointed out that the stigma remains knoblike or capitate in *Cyrtophyllum* and *Picrophloeus*, but its basal part develops a rim as it matures, producing an overall peltate form in *Fagraea* s.s., *Limahlania* and *Utania*.

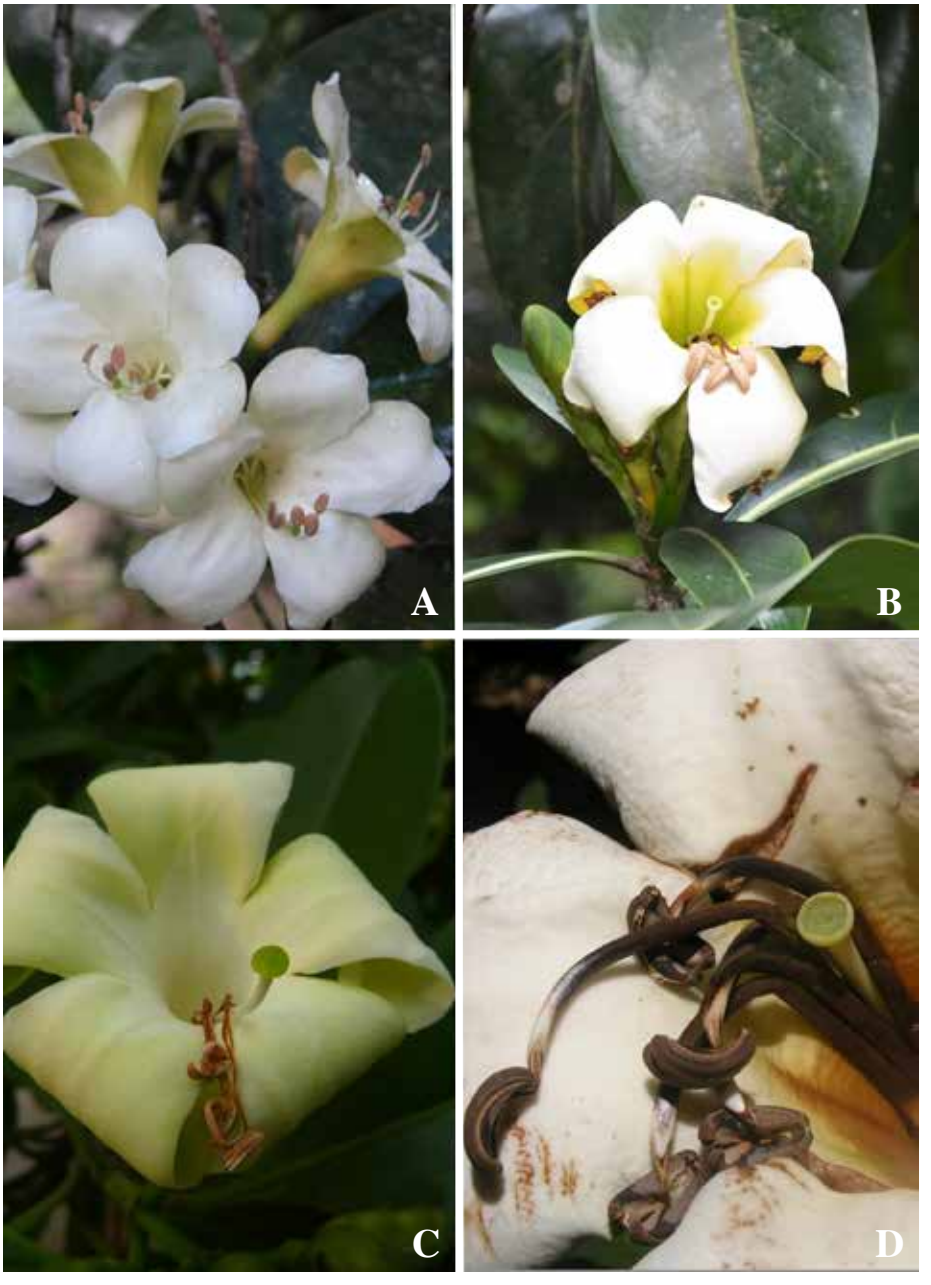

Fig. 5. Protandry in *Fagraea* flowers. **A.** Freshly open blooms of *Fagraea fraserensis* (*Sugumaran & Low* SM163). **B.** *Fagraea auriculata* flower with near-dehicing anthers and young cup-like stigma with ascending rim (*Sugumaran* SM 25). **C.** *Fagraea splendens* flower with senescent stamens and stigma in receptive stage, with mound-like structure. **D.** *Fagraea imperialis* flower with long-senescent stamens and a stigma past its prime, with an incurved rim (*Sugumaran et al*. SM 230). (Photo credits: A, B & D, M. Sugumaran; C, Ang Wee Foong)

Fig. 6. *Fagraea auriculata*. **A.** Flowers. **B.** Fruits. **C.** Creamy yellowish latex oozing from torn fruit calyx. **D.** Axile placentation demonstrated with serial sectioning of a fruit from apex (top right downwards, to base (upper and lower left). (B–D, *Sugumaran* SM 25) (Photo credits: A, Ang Wee Foong; B, C & D, K.M. Wong)

Fruits and seeds

The fruit in *Fagraea* is a berry (Leenhouts 1962). The shape of the fruit varies from globular to narrowly ellipsoid and the only confident records of dehiscence upon fruit maturity appear to be for *Fagraea auriculata* (Ridley 1908; also Leenhouts 1962) and *F. imperialis* (Ridley 1930). Ripe fruit colour ranges from pale greenish-grey to mild yellow to red (Leenhouts 1962, Kochummen 1973). In *Fagraea auriculata*, the placenta of the fruit often remains erect in the centre following dehiscence and is very attractive to birds and ants, in contrast to the unpleasant bitter fruit pericarp (Ridley 1908). Ridley (1930) records bulbuls dispersing this species' seeds. Ridley (1930) noted that seeds of *Fagraea imperialis* were dispersed by birds drawn to eating the sweet orange fruit pulp.

Sugumaran & Wong (2012) noted that fruits in *Fagraea* s.s. are typically large at maturity (when dried, more than 4 cm diameter), and smaller (1.5 cm or less) in the related genera *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*. In *Utania*, the fruit epidermis remains intact and does not detach upon drying, compared to the other four genera including *Fagraea* s.s., in which the epidermis separates easily as a tough translucent 'peel' (Sugumaran & Wong 2012).

Leenhouts (1962) merely notes irregularly angular seeds for *Fagraea* as a whole. Wong & Sugau (1996) pointed out two seed forms: angular in *Cyrtophyllum*, *Limahlania*, *Picrophloeus* and *Utania*, and ellipsoid-rounded in *Fagraea* s.s.

TAXONOMIC TREATMENT

Fagraea Thunb.

Kongl. Vetensk. Acad. Handl. 3 (1782) 132, t. 4. TYPE SPECIES: *Fagraea ceilanica* Thunb., Kongl. Vetensk. Acad. Handl. 3 (1782) 132, t. 4. LECTOTYPE (Wong & Sugumaran 2012a): *Thunberg s.n.*, "e Ceilona" (UPS: no. 004308; isolecto S: no. S07-8227, isolecto SBT: barcode SBT12824, isolecto UPS: no. 004309).

Epiphytes, hemi-epiphytes, scramblers and small trees. ***Trunk*** with episodic growth; bark smooth to lightly scaly-dippled. Vegetative shoot tips with creamy yellowish resin. ***Leaves***: arrangement on branches decussate; leaf margin entire; petiolar sheaths of a leaf pair not to slightly fused at the edges, each with a scale-like ligular structure in the axillary position. ***Inflorescences*** terminal; of a solitary flower or a many-flowered and branched cyme with basal branches nearly as long as, or longer than, the rachis. ***Flowers*** small to large (up to 50 mm wide at the mouth); stamens slightly to medium exsert; ovary unilocular with two parietal placentas or bilocular with axile placentas; style not to slightly exsert; mature stigma peltate. ***Fruits*** small to big (up to about 40 mm in diameter); colour at maturity often creamy

pale grey-green ranging to red; with copious creamy pale yellowish latex in fruit epidermis and fruit wall; epidermis separating as a thin translucent film from pericarp (fruit surface appear crinkled on herbarium specimens). ***Seeds*** ellipsoid-rounded.

KEY TO *FAGRAEA* SPECIES AND VARIETIES IN THE MALAY PENINSULA

(Note: Although only flower buds and fruits (not corollas) are known for *Fagraea cameronensis*, it is assumed to have infundibular corollas, as do all other species in the genus in the Malay Peninsula that, like it, also have smaller flowers in branched cymes.)

1a. Leaf base attenuating at the base and forming rounded auricles just above the petiolar sheath. ..... **6. *F. fastigiata***

1b. Leaf base not decurrent to the petiole base and without auricles, or, if decurrent and auricles present, the auricles formed at the petiole base below the petiolar sheath,

2a. Petiole base with narrow, rimlike to broad, rounded, auricular lateral extensions,

3a. Corolla very big, the tube 9.5–17 cm long, the lobes 6.5–7.5(–8) cm long. Leaves located several nodes below inflorescences often very big, to 25–36 cm long. Branch internodes each developing a pair of keels 2–5 mm broad along the inter-petiolar region. ... . **9. *F. imperialis***

3b. Corollas smaller, the tube shorter than 9 cm, the lobes less than 6 cm long. Leaves located several nodes below inflorescences usually smaller, shorter than 25 cm (only exceptionally to 31 cm long). Branch internodes each developing only 2–several ridges at most 1 mm high along the inter-petiolar region, not plate-like keels,

4a. Flowers 2-several in cymes. Floral bracts small, acute, less than 14 mm long and located clearly below the calyx. Petiole base auricles typically large and rounded, (3–)8–15(–20) mm broad. Leaves located several nodes below inflorescences 16–22(–31) cm long. ..... **1. *F. auriculata***

4b. Flowers solitary. Floral bracts small to large, rounded, (7–)15–30(–35) mm long, often forming an involucre-like arrangement around the calyx together with a pair of expanded inflorescence bracts (when these are present). Petiole base auricles often smaller, varying from narrow lateral extensions 1–2 mm broad to lobelike structures 2–7 mm broad. Leaves located several nodes below inflorescences 11–18(–22) cm long. .. .. **10. *F. kinghamii***

2b. Petiole base without auricular structures,

5a. Leaf secondary veins distinct and prominent on the lower surface upon drying,

6a. Flower calyx larger, the lobes 13–15 mm long. Cymes little-branched, with 1–2 pairs of primary branches, the basal pair just 10–30 mm long, these typically rebranching just once (exceptionally to 2 orders). Inflorescence rachis thicker, 5–8 mm thick. Leaves very thick-coriaceous, with rounded apices. ..... **16. *F. ridleyi***

6b. Flower calyx smaller, the lobes only 5–10 mm long. Cymes more branched, with 2–3 pairs of primary branches, the basal pair (10–)28–50(–60) mm long, these rebranching 1–2(–3) orders. Inflorescence rachis more slender, 2.5–3(–4) mm thick. Leaves thin-coriaceous, with short-cuspidate apices. ..... **15. *F. renae***

5b. Leaf secondary veins indistinct or, if faintly visible, immersed in the lamina and not prominent upon drying,

7a. Calyx lobes with auriculate bases. ..... **7. *F. fraserensis***

7b. Calyx lobes without auriculate bases,

8a. Leaf surface drying parchment-like, with a smooth surface, and greenish or grayish. Floral bracts inconspicuous, present only as very tiny structures below the calyx base or on the pedicel, measuring less than 0.5 mm long. ..... **14. *F. oblonga***

8b. Leaf surface drying shagreen or grainy, and light greenish brown to dark brown. Floral bracts conspicuously larger and overlapping the calyx base, or small and acute and located below the calyx base, measuring 1 mm or longer in either case,

9a. Flower calyx longer, (12–)15 mm long or more,

10a. Corolla tube essentially cylindrical or slender trumpet-shaped, with only a very gradual increase in width from the base to mouth,

11a. Flowers solitary. Corolla tube 10–14 cm long. ..... **3. *F. carnosa***

11b. Flowers in a 1–several-flowered cyme. Corolla tube 4–5.3 cm long. .... **8. *F. gardenioides***

10b. Corolla tube infundibular with a narrow tubular basal part and widely flared upper portion,

12a. Corolla lobes larger, 35–40 mm long × 25–30 mm wide. Corolla mouth wider, 30–32 mm wide. (Occurring only in limestone outcrops and their vicinity.) (**5. *F. curtisii***)

13a. Floral bracts smaller, 3–5 mm long. (Northwest and west-coast Peninsular Malaysian limestones.) ..... *F. curtisii* var. *curtisii*

13b. Floral bracts larger, 7–18 mm long. (Pahang and east-coast Peninsular Malaysian limestones.) ..... *F. curtisii* var. *calcarea*

12b. Corolla lobes smaller, 15–27 mm long × 9–20 mm wide. Corolla mouth narrower, 16–18 mm wide. (Occurring in lowlands and lower montane forests.)

14a. Flowers solitary. Floral bracts bigger, 17–18 mm long, rounded and overlapping the calyx base. ..... **12. *F. latibracteata***

14b. Flowers in a cyme. Floral bracts smaller, less than 7 mm long, acute, and located below the calyx base,

15a. Calyx smaller, 17–18 mm long and 5–6 mm wide. Corolla lobes smaller, 15–16 mm long and 9–10 mm wide. Corolla tube shorter, 20 mm long or less. ..... **11. *F. larutensis***

15b. Calyx bigger, 20–26 mm long and 9–10 mm wide. Corolla lobes bigger, 20–27 mm long and 15–20 mm wide. Corolla tube longer, 26–30 mm long. .... **4. *F. crassifolia***

9b. Flower calyx shorter, 10 mm long or less,

16a. Inflorescence branches indistinct or extremely short, not longer that 3–4 mm, with few to many flowers crowded together,

17a. Corolla tube slender, essentially cylindrical, not exceeding 6 mm across at the mouth. Leaves ovate. ..... **18. *F. tubulosa***

17b. Corolla tube infundibular, 10–15 mm across at the mouth. Leaves elliptic to obovate. ..... **17. *F. splendens***

16b. Inflorescence branches distinct, the basal branches longer, more than 11 mm long and often much longer, the flowers not tightly bunched together,

18a. Fruits broadly ovoid or subglobbose, 13–15 mm in diameter. Mature fruit calyx recurved (folding backwards) away from the fruit base in dried material. Basal inflorescence branch pairs not rebranching. (Coastal areas.) .... **13. *F. littoralis***

18b. Fruits narrowly ellipsoid, not more than 8 mm across. Mature fruit calyx tightly clasping the fruit base in dried material. Basal inflorescence branch pairs rebranching once. (Highlands.) ..... **2. *F. cameronensis***

1. *Fagraea auriculata* Jack

Mal. Misc. 2, no. 7 (1822) 82; Wallich ex Roxburgh, Fl. Ind. 2 (1824) 34; Craib & Kerr, Fl. Siam. Enum. 3 (1) (1951) 54; Griffin & Parnell, Fl. Thailand 6 (3) (1997) 204. NEOTYPE (Wong & Sugau, Sandakania 8 (1996) 51): *Wray 2913*, Perak (L).

Fagraea auriculata auct. pro parte, excl. *F. imperialis* Miquel in syn.: Clarke in Hooker f., Fl. Brit. Ind. 4 (1885) 83; King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 605; Ridley, Fl. Malay. Pen. 2 (1923) 416.

Fagraea auriculata sensu Leenhouts, Fl. Males. I, 6 (2) (1962) 326 pro parte, excl. *F. imperialis* Miq. in syn., ssp. *borneensis* (= *F. borneensis* Scheffer & *F. euneura* Scheffer) & ssp. *parviflora* (= *F. euneura* Scheffer & *F. epiphytica* Elmer).

Fagraea auriculata sensu Kochummen, Tree Fl. Malaya 2 (1973) 270 pro parte, tantum speciminia altitudine infra 1000 m peninsulae Malayensis neque speciminia montium.

Fagraea auriculata sensu Wong & Sugau, Sandakania 8 (1996) 51 pro parte, excl. Fig. 16, *Symington KEP 36092*, *Whitmore FRI 12214*, *15551* (= *F. kinghamii* K.M.Wong & M.Sugumaran).

(Fig. 2A–C, 3B, 5B, 6)

Small tree to large terrestrial shrub or hemi-epiphyte, 5–18 m tall trees or 5–20 m tall on trees as hemi-epiphytes; trunk/stems to c. 10 cm diameter; bark smooth, grey-brown to reddish brown, smooth becoming scaly-dippled; branch internodes often with 2-several low ridges 1 mm broad along the inter-petiolar region. **Leaves** elliptic to oblanceolate; (12–)18–27(–31) cm long, (4.5–)5.5–9(–11) cm wide; *base* narrowly decurrent with 1–2 mm broad wings towards the petiole base; *apex* rounded to shortly pointed; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* prominent above, more prominent below with a slight median keel upon drying; *secondary veins* 4–6(–7) pairs, faint and immersed in the lamina on both sides; *tertiary and higher-order veins* faint; petioles 15–25(–35) mm long, 3–5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule (1.5–)2–3 mm high adaxially; *auricles* developing below the petiole base, distinct from the lamina base, typically forming broad, rounded, reflexed lobes (3–)8–15(–20) mm broad (very rarely raised lateral rims just 1–2 mm high). **Inflorescence** terminal, a 2- to few-flowered cyme, the whole about (1.5–)2–3(–4) cm long; *peduncle* indistinct; inflorescence *rachis* (1.5–)2–3(–4) cm long, 5–7 mm diameter, with 1(–2) pairs of primary branches; basal primary *branch pairs* c. 12–22 mm long, 5–8 mm diameter and not rebranched. **Flowers** fragrant, bisexual; *pedicels* 3–10(–20) mm long, 8–10 mm diameter; *floral bracts* small, acute, 8–10(–13) mm long, located below the calyx; *calyx* 27–33 mm long (from the base to the lobe apices), glabrous, not lenticellate, *calyx cup* 15–18 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 20–27 mm long, 12–17 mm wide, margins glabrous,

base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 30–35(–45) mm long, 10–12(–17) mm wide basally, *upper flared part* of the tube slightly inflated, 30–37 mm long, 40–56(–60) mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 36–42 mm long, 23–31 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 45–60 mm long, protruding to 15–23 mm from the corolla mouth; *anthers* versatile, hastate, 13–15 mm long, 6–8 mm wide, each anther sac somewhat ellipsoid; *style* 70–90 mm long, protruding to 8–10 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, the whole 3–4 mm across. **Infructescence** peduncle indistinct. **Fruit** narrowly ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to (65–)80–101 mm long, 25–35(–40) mm diameter; the base tightly clasped by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, c. 1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Java, Sumatra, Malay Peninsula, Indo-China.

HABITAT. Coastal sites, including behind sea beaches, rocky outcrops, swamp forests; also limestone and quartz outcrops in coastal lowlands.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Batu Pahat, Patani, *Ridley s.n.*, FR, no precise date, 1900 (SING); Kota Tinggi, Nam Heng Estate, *Teruya 229*, FL (SING); Pontian, Pengkalan Raja, *Ngadiman SFN 36752*, FL, 3 Jul 1939 (SING); Sedili Kechil, *Corner s.n.*, FB, 22 Jun 1934 (SING); Sungei Tebrau, *Ridley 11639*, FR, no precise date, 1903 (SING). **Melaka.** *Alvins 2053*, FL, no date (SING), *Griffith s.n.*, FL, 1845 (BR), *Maingay 1025*, FL, no date (L); Alor Gajah, *Bland s.n.*, FR, 24 Aug 1902 (SING); Merlimau, *Derry 1218*, FL, Jul 1892 (SING). **Pahang.** Bukit Nipah, cliff, *Samsuri SA 915*, FR, 24 Feb 1974 (SING); Kuantan, Baloh F.R. Compt. 1, sandy, *Rahim KEP 97950*, FB, 30 Jul 1966 (KEP, SING), FB, FL (SING); Menchali Forest Reserve, *Sugumaran SM 25*, FB, FR, 19 Apr 2004 (KLU), *Sugumaran SM 217*, leafy twig only, 4 Jun 2008 (KLU); Nenasi, Merchong, *Sugumaran SM 13*, leafy twig only, 17 Apr 2004 (KLU); Pekan, *Ahmad AS 119*, FR, 9 Mar 1973 (SING), *Ridley 2170*, FB, FL, no precise date, 1891 (SING); Pulau Tioman, west coast near Kampong Paya, rocky shore, *Ratnasabapathy s.n.*, FB, 26 May 1974 (KLU); Telok Kuantan, *Henderson s.n.*, FB, 19 Aug 1929 (SING). **Perak.** Dindings, Bruas, *Ridley 7998*, FB, FL, Mar 1896 (SING); Pangkor, *Foxworthy CF 1726*, FR, 30 Mar 1918 (KEP, SING); Sungai Krian Estate, sea level, *Spare SFN 36007*, FB, FL, 10 Jul 1938 (SING). **Selangor.** Bukit Takun, *Boey 421*, leafy twig only, 19 Sep 1971 (KLU), Bukit Takun, *Stone 5915*, leafy twig only, 11 Jul 1965 (KLU); Klang Gates ridge, *Boey 398*, leafy twig only, 12 Sep 1971 (KLU), *Carrick 659*, leafy twig only, 19 Mar 1960 (KLU), *Mahmud s.n.*, FR, Jul 1970 (KLU), *Sugumaran SM 28*, leafy twig only, 20 Jan 2005 (KLU), 800 [244 m]

alt, *Stone 14110*, leafy twig only, 22 Jul 1979 (KLU), 1000 ft [305 m] alt, *Henderson SFN 10490*, FB, FL, 6 Aug 1923 (SING). **Terengganu.** Dungun, *Soepadmo KLU 9103*, FR, 30 Apr 1968 (KLU); Gong Balai near beach, *Shah & Sidek MS 4045*, FR, 24 Nov 1978 (SING); Jambu Bongkok, *Johnson AJ 4036*, FR, 3 Mar 1967 (KLU). **PENINSULAR THAILAND. Nakawn Sritamarat.** Songkla Kau Keo, *Kerr 15962*, FL, 1 Jul 1928 (BK). **Phuket.** Krabi, Tambon Kao Panom, *Kerr 18837*, FR, 3 Apr 1930 (BK); Ranawng, Kaw Chang, *Kerr 16603*, FL, 11 Jan 1929 (BK). **SINGAPORE.** no locality, *Hullett 164*, FR, Jul 1885 (SING); *Wallich s.n.*, 1822, FL (calyx fragment) (BM: barcode BM001014285), Pulau Pawai, Tanjong Berhala Kuda, *Sinclair SFN 38900*, leafy branch only, 14 Mar 1950 (SING), Pulau Pawai, *Sinclair s.n.*, leafy branch only, 26 Mar 1951 (L); Pulau Ubin, *Ridley 9582*, FB, FL, no precise date, 1898 (SING), near Outward Bound School, *Lim SING 2011-285*, FL, 27 Jul 2011 (SING). **SUMATRA** (INDONESIA). Riouw, Indragiri, Bovenlanden, Kuala Belilas, swampy, *Buwalda 6774*, FB, 29 Apr 1939 (SING). **THAILAND.** Lower Siam, Pulau Song Pinang, *Haniff & Nur s.n.*, FR, 12 Dec 1918 (SING).

Jack (1822) had intended a lowland, predominantly coastal, taxon when he mentioned that his species was collected from Singapore and the west coast of Sumatra at Tapanuly. As there was no type provided (Merrill 1952), a neotype has been designated by Wong & Sugau (1996) which conforms to this. When the Peninsular Malaysian material grouped by both Leenhouts (1962) and Wong & Sugau (1996) under *F. auriculata* was sorted for the present study, three taxa were distinct.

The first, *Fagraea auriculata* Jack, represented by the neotype, is a coastal species with conspicuous leaf-stalk auricles and medium-sized flowers (corolla tube 30–35(–45) mm long) in cymose inflorescences, with distinct, slender pedicels (8–10 mm thick) and infundibular corolla. Floral bracts are small (8–10(–13) mm long), acute and found on the pedicels. This species also occurs at several other sites, such as limestone hills (e.g., Bukit Takun, Selangor) and quartz ridges (e.g., the Klang Gates ridge outside Kuala Lumpur).

The second species is *Fagraea imperialis*, also with conspicuous leaf-stalk auricles but huge, highly distinctive flowers (corolla tube (40–)90–100 mm long), either solitary or in small numbers in cymes. The corollas are infundibular with overall much larger dimensions than in *F. auriculata* and with a thicker tube. The floral bracts are larger (typically 20–30 mm long) and rounded compared to those of *Fagraea auriculata*. This species is found in (and typified by material from) Sumatra but is now adequately represented by good material recently gathered from Perak, Peninsular Malaysia (*Sugumaran SM 238*) (see under that species), allowing diagnosis of several other Peninsular Malaysian collections from both coastal and inland sites. A further difference between *Fagraea imperialis* and *F. auriculata* is the development of strong, sharp keels along the inter-petiolar median of internodes in the former, whereas in *F. auriculata* the internodes are either smooth or at most provided with low ridges without any plate-like keels developing.

The third component of the Peninsular Malayan material (here named *Fagraea kinghamii*) is distinctive by the typically solitary flowers with much shorter pedicels (indistinct or to only 10 mm long) and a montane provenance (so far documented only from the Peninsular Malaysian Main Range). The leaf-stalk auricles are poorly developed, ranging from narrow rim-like structures to distinct auricles just several mm wide, not as pronounced as those of *Fagraea auriculata* or *F. imperialis*. The corollas are medium-sized (corolla tube 22–30 mm long), infundibular and similar to those in *Fagraea auriculata*. The floral bracts are large (typically 30 mm long), rounded, and can approach the size of calyx lobes. This species is illustrated in Wong & Sugau (1996) as their Fig. 16, which they placed under *Fagraea auriculata*.

2. *Fagraea cameronensis* K.M.Wong & M.Sugumaran, **sp. nov.**

Fagraeae rarissimae similis sed cymis pauci ramosis, bracteis floralibus inconspicuis et floribus minoribus differt.

TYPE: *Burkill HMB 818*, Pahang, Cameron Highlands, Sungai Uruil, below Golf Course, 4800 ft [1463 m], 4 Sep 1956 (holo SING).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *Burkill HMB 818*.

(Fig. 7)

Small tree or hemi-epiphyte, usually to 5 m tall or to 17 m high or more on trees; trunk/stems to c. 10 cm diameter; bark smooth, grey-brown. **Leaves** elliptic to obovate; (6–)8–11(–13.5) cm long, (2–)3–4(–4.3) cm wide; *base* cuneate, not decurrent; *apex* short blunt cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat to sunken above, prominent below; *secondary veins* 6–9 pairs if visible, otherwise obscure on both sides; *tertiary and higher-order veins* obscure; petioles 8–10 mm long, 1.5–2.5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 2.1–3.3 cm long; *peduncle* indistinct; inflorescence *rachis* 21–33 mm long, 2–2.5 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 18–26 mm long, 1.5–2 mm diameter and rebranched to 1 order, more distal branch pairs not so. **Flowers** bisexual; *pedicels* 2–3 mm long, 2–3 mm diameter; *floral bracts* small, acute, 1–2 mm long, located below the calyx; *calyx* 8–10 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 3–4 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 3–4 mm long, 4–5 mm wide, margins glabrous, base not auriculate; *corolla* not known; *stamens* not known; *style* not known. **Infructescence** peduncle indistinct. **Fruit** narrowly ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 12–20 mm long, 5–8 mm diameter;

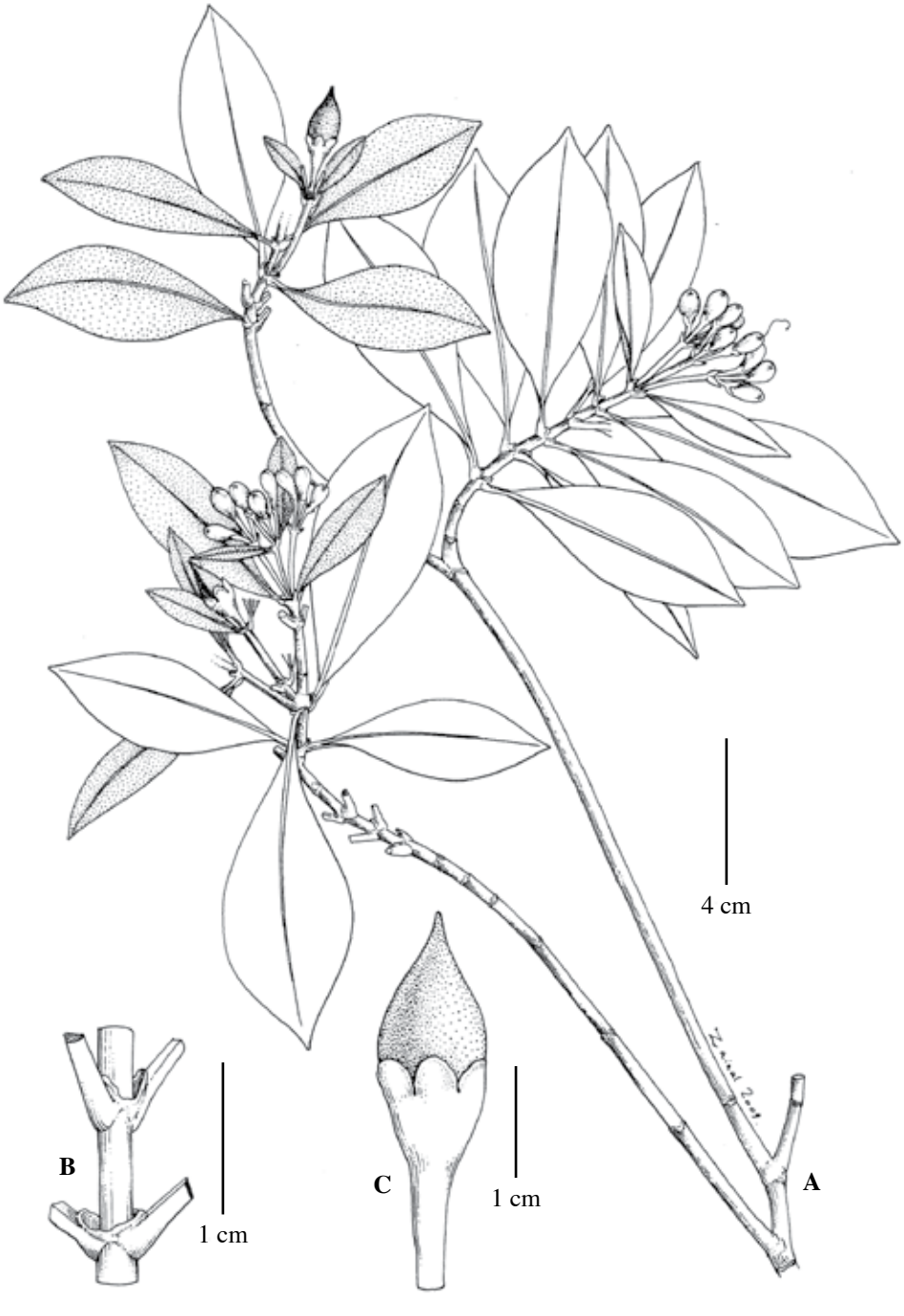

Fig. 7. *Fagraea cameronensis*. **A**. Leafy branch with buds and fruits. **B**. A portion of stem featuring leaf stalk bases with scale-like ligules on adaxial side. **C**. Fruit. All from *Burkill HMB 818* (holotype, SING). (Drawing by Zainal Mustafa)

the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 1.5–2 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Known only from Peninsular Malaysia (Cameron Highlands).

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Pahang. Cameron Highlands, Sungai Uruil, below Golf Course, 4800 ft [1463 m] alt, *Burkill HMB 818*, FB, FR, 4 Sep 1956 (SING); Cameron Highlands, trail to G. Berembun, 5500 ft [1676 m] alt, *Ng FRI 5930*, FR, 1 Mar 1968 (KEP, SING); Cameron Highlands, Gunung Brinchang, *Low LYW 138*, leafy twig only, 29 Jul 2007 (KLU).

This species is similar to *Fagraea rarissima* K.M.Wong & Sugau and *F. longipetiolata* K.M.Wong & Sugau from Borneo in having relatively small flowers 1-several together in little-branched cymes (without floral-bract involucres), indistinct leaf veins and non-auriculate leaf-stalk bases. It can be distinguished from these species even in the absence of corollas. *Fagraea cameronensis* has smaller flower calyx lobes, 3–4 mm long (4–5 mm long in *F. rarissima*, 6–8 mm long in *F. longipetiolata*). The central inflorescence axis in *Fagraea cameronensis* is 12–24 mm long, whereas in *F. rarissima* it is only up to 10 mm long. The leaf margins are not recurved when dry (unlike in *Fagraea rarissima*), and the leaf apices are acute to cuspidate (unlike in *F. longipetiolata*, where they are consistently caudate).

ETYMOLOGY. Named after the Cameron Highlands, Peninsular Malaysia, where this species occurs.

3. *Fagraea carnosa* Jack

Mal. Misc. 2, no. 7 (1822) 81; Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 323. NEOTYPE (here chosen): *Teysmann HB 998*, Sumatra, Sibogo (U: barcode U0003706 & acc. no. 38976; isoneotype L: barcode L0004965 & acc. no. 908127-712).

Fagraea flavidula Ridl., Fl. Malay. Pen. 5 (1925) 322. TYPE: *Henderson SFN 11673*, Pahang, Cameron Highlands (holo K: barcode K000883556; iso K: barcode K000883557, L, SING).

Fagraea monantha Miq., Fl. Ind. Bat. 2 (1857) 373. TYPE: *Teysmann HB 998*, Sumatra, Sibogo (holo U: barcode U0003706 & acc. no. 38976; iso L: barcode L0004965 & acc. no. 908127-712).

Fagraea uniflora Merr., J. Str. Br. R. As. Soc. 77 (1917) 235. TYPE: *Foxworthy 114*, Sarawak, Santubong (iso L).

Fagraea rotundifolia Ridl., J. Str. Br. R. As. Soc. 50 (1908) 117. TYPE: *Rostado s.n.*, Tringganu, Bundi (holo K).

Fagraea carnosa sensu Clarke in Hooker f., Fl. Brit. Ind. 4 (1885) 82 pro parte, excl. speciminia origine 'Tenasserim'.

Fagraea carnosa auct. pro parte, excl. speciminia origine 'Burma': King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 604; Ridley, Fl. Malay. Pen. 2 (1923) 416; Leenhouts, Fl. Males. I, 6 (2) (1962) 331; Kochummen, Tree Fl. Malaya 2 (1973) 271.

(Fig. 8)

Scrambler or hemi-epiphyte, usually to 2–3 m high or more on trees; stems to c. 5 cm diameter; bark smooth, grey-brown. **Leaves** elliptic-obovate to orbicular; (6–)8–13(–16.5) cm long, (2.8–)4–6(–7) cm wide; *base* cuneate to rounded, not decurrent; *apex* short cuspidate to rounded; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* obscure on both sides; *tertiary and higher-order veins* obscure; petioles (7–)15–22 mm long, 2–4 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–3 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, consisting of a solitary flower; *peduncle* distinct, (3–)4–6 mm long, 4–6 mm diameter; the rachis internode between peduncle and pedicel inconspicuous. **Flowers** very fragrant; bisexual; *pedicels* 3–5 mm long, 4–6(–7) mm diameter; *floral bracts* small, acute, 3–5 mm long, located below the calyx; *calyx* 15–21(–34) mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 7–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 10–12(–16) mm long, 7–10 mm wide, margins glabrous, not auriculate; *corolla* subsalverform (with an elongate narrow lower tubular part and a much shorter upper flared part, spreading to erect lobes); cream to white; *lower subcylindrical part of the corolla tube* 10–13 cm long, 8–10 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, 6–10 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 22–35(–46) mm long, 10–18 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 12–15 mm long, protruding to c. 5 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 2–3 mm wide, each anther sac somewhat ellipsoid; *style* 12.3–12.6 cm long, not or protruding to 10–17 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 3–4 mm across. **Infructescence** *peduncle* distinct, 5–7 mm long, 5–6 mm thick. **Fruit** broadly ovoid to ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 35–50(–57) mm long, 20–28 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1.5–2 mm wide; testa surface areolate.

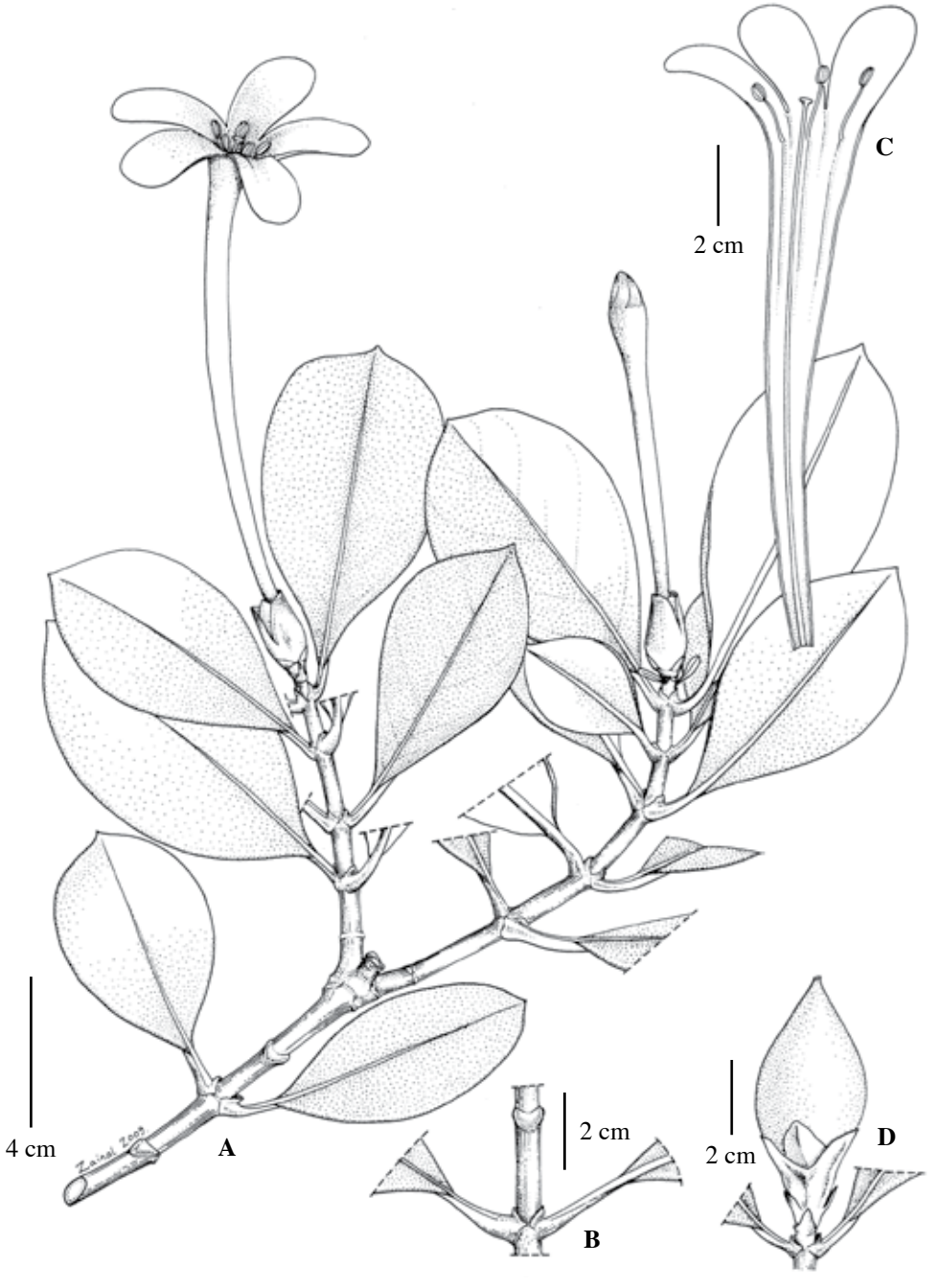

Fig. 8. *Fagraea carnosa*. **A**. Leafy branch with flowers. **B**. Portion of stem with scale-like ligules on the adaxial side of the petiole bases. **C**. Longitudinal section of corolla showing the attachment of stamens. **D**. Fruit. A & B from *Chin 367* (KLU), C from *Yao FRI 53078* (KEP) and D from *Chin 566* (KLU). (Drawing by Zainal Mustafa)

DISTRIBUTION. Borneo (Sarawak), Malay Peninsula, Sumatra. There seems to be no clear record of this species in Thailand (Griffin & Parnell 1997).

HABITAT. Coastal islands, lowland rain forest to lower montane forest; in the lowlands also found on some limestone hills.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kedah. Gunong Bintang F.R., 1000 ft [304 m] alt, *Sidek S 282*, FR, 8 Apr 1968 (SING). **Kelantan.** Gunung Stong, eastern face, granite cliff, 1000 ft alt [304 m] alt, *Whitmore FRI 12518*, FB, FL, 15 Aug 1969 (KEP, SING). **Pahang.** Bukit Serdam, 1300 ft [396 m] alt, *Henderson s.n.*, FL, FR, 6 Oct 1931 (SING); Cameron Highlands, 4800 ft [1463 m] alt, *Henderson SFN 11673*, FB, FL, FR, 16 Jan 1924 (K, SING); Cameron Highlands, Tanah Rata, 5000 ft [1524 m] alt, *Henderson SFN 17729*, FR, 17 Nov 1925 (SING); Fraser's Hill, 4000 ft [1219 m] alt, *Nur SFN 11288*, FR, 7 Sep 1923 (SING); Fraser's Hill, 'dekat tepi Padang Gof', *Medan KEP 45409*, FL, FR, 9 Nov 1937 (KEP); Pahang, Lesong F.R., *Chan FRI 25183*, FR, 8 Jun 1979 (KEP); Raub, Gua Kechil limestone hill, 350 m alt, *Chin 1151*, leafy branch only, 21 Jun 1971 (KLU). **Penang.** Pulau Boetong, *Curtis 3394*, FL, no date (SING). **Perak.** Dindings, Lumut, *Ridley 10297*, FL 1899 (SING); Pangkor Island, *Curtis s.n.*, FL, Feb 1900 (SING), north coast, rocky headland, *Whitmore FRI 3009*, 17 Feb 1967, FR (KEP), FB (SING). **Selangor.** Batu Caves, *Wyatt-Smith KEP 85211*, FR, 29 Dec 1957 (KEP), 800 ft [244 m] alt, *Ng FRI 1627*, leafy branch only, 14 May 1966 (KEP, SING); Bukit Takun, *Allen s.n.*, FL, 27 Jan 1957 (SING), *Boey 422*, leafy branch only, 19 Sep 1971 (KLU), *Sinclair s.n.*, FL, 27 Jan 1957 (SING), *Sow & Tachun KEP 35092*, FB, FL, 17 Sep 1940 (KEP), *Sugumaran & Lee SM 186*, leafy branch only, 20 Mar 2008 (KLU), 500 m alt, *Chin 566*, FR, 31 Dec 1970 (KLU), near summit, 1000 ft [304 m] alt, *Stone 11079*, FR, 4 Mar 1973 (KLU), summit, *Chin 367*, FB, FL, 27 Sep 1970 (KLU). **Terengganu.** Bundi, *Rostado s.n.*, FL, Feb 1904 (K); Dungun, Tanjong Gadong Forest Reserve, rocky seashore, *Yao FRI 53078*, FL, FR, 26 Sep 2006 (KEP, KLU, SAN, SAR). **SUMATRA** (INDONESIA). Sibogo, *Teysmann HB 998*, no precise date FB (L), FB (U).

In his description, Jack (1822) states only "In the neighbourhood of Bencoolen" with no mention of other localities and so had clearly intended a Sumatran taxon. His description of "Flowers. . . solitary, nearly sessile. . . Corolla. . . tube about four inches long" and "Leaves. . . subrotund with a short reflexed point, entire with reflexed margins, very. . . thick and fleshy" distinguishes the species adequately. However, no original material that could be regarded as typifying Jack's name could be found. Leenhouts (1962) remarks, "Among the few Sumatran specimens at my disposal none fits his description very well, and there is no later collection from. . . Bencoolen, S. Sumatra". The specimens *Rahmat 6254* and *Jacobs 4610* (L) are both fruiting collections without corollas and the meagre flowering material in *Teysmann HB 998* (also the type of *Fagraea monantha* Miq.) is represented by two half-calyx portions at L and a very young flower bud at U. Neotypification is essential and should be based on Sumatran material, so we choose the Teysmann specimen at U as it is the best, including a good leafy branch and a flower bud.

In the Kew herbarium, the type of Ridley's *Fagraea rotundifolia* has a neotype label for the name *F. carnosa* on it. This should not be accepted as a neotype because it had not been clearly designated by Leenhouts (1962), who, however, stated "The only specimen which is well in accordance with the original diagnosis is Rostado s.n. . . . the type of *F. rotundifolia* Ridl." Although we accept some variation that includes this specimen, it has a flower with a bigger calyx than the Sumatran or other Malayan material and more closely resembles the calyces in Bornean material. In addition to this, the leaves in the Rostado collection are atypically rotund (all other material has elliptic to obovate leaves with mostly rounded apices).

4. *Fagraea crassifolia* Blume

Rumphia 2 (1838) 31, t. 78 f. 1; Mus. Bot. 1 (1850) 166. TYPE**:** *Collector unknown*, Java (holo L: acc. no. 908127-756 & barcode L0004983).

Fagraea sparei M.R.Hend., Gard. Bull. S.S. 7 (1933) 114. TYPE: *Spare F952*, Johore, Sungai Tukong Estate (holo SING; iso K).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *F. crassifolia* Blume & *F. sparei* M.R.Hend. in syn; Kochummen, Tree Fl. Malaya 2 (1973) 271 pro parte, quoad *F. sparei* M.R.Hend. in syn.; Griffin & Parnell, Fl. Thailand 6 (3) (1997) 201 pro parte, quoad *F. obovata* Wall. in syn.

Fagraea lanceolata auct. non Blume (1826): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 607, quoad *Kunstler 6848* & *Wray 3202*.

Hemi-epiphyte, 20–30 m high or more on trees; trunk/stems to c. 15 cm diameter; bark smooth, grey-brown. **Leaves** elliptic to subobovate; (5.5–)8–12(–13.5) cm long, (2.3–)3.8–5.5 cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* flat above, prominent below; *secondary veins* obscure on both sides; *tertiary and higher-order veins* obscure; petioles 10–20 mm long, 2–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 10–15 mm long; *peduncle* indistinct; inflorescence *rachis* 10–15 mm long, 2–3 mm diameter, with 1 pair of primary branches; basal primary *branch pairs* 5–15 mm long, 2–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* indistinct or to 7 mm long, to 4 mm diameter; *floral bracts* small, acute, 5–6 mm long, located below the calyx; *calyx* 20–26 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 9–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 10–13 mm long, 10–12 mm wide, margins glabrous, base not

auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 16–17 mm long, 5–6 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, 10–13 mm long, 16–18 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 20–27 mm long, 15–20 mm wide, overlapping to the right; *stamens* not seen (broken off in available material); *style* 28–30 mm long, protruding to c. 2 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 2–3 mm across. **Infructescence** *peduncle* indistinct. **Fruit** broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 40–50 mm long, 25–32 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1.5–2 mm wide; testa surface areolate.

DISTRIBUTION. Java, Malay Peninsula.

HABITAT. Lowland rain forest to lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Kluang State Land, *Yeob CF 5849*, FR, 17 Feb 1922 (KEP, SING); Sungai Tukang Estate, *Spare F952*, FB, 13 Sep 1931 (K). **Melaka.** *Griffith 3737*, FL, no precise date, 1845 (K). **Pahang.** Ulu Telom, Cameron Highlands, *Jaamat & Lasah FMS 27672*, FL, FR, 30 Aug 1931 (KEP, SING). **Perak.** Maxwell's Hill, *Wray 3202*, FR, Sep 1838 (K, SING). **JAVA** (INDONESIA). *sine coll*. FB, FR, no date (L: acc. no. 908127-756 & barcode L0004983).

Wallich's name *Fagraea obovata* has a number of confusing elements and is not used. In the original description (Roxburgh 1824), Wallich includes material from both Silhet (now Bangladesh) as well as Singapore. Clarke in Hooker (1885) pointed out that the "corolla in Wallich's Silhet example is considerably larger than in his Singapore one." Yet in his description, Wallich appears to describe the flowers of the taxon from Silhet (which Clarke points out has leaves with distinct primary nerves), and leaves that are "fleshy, without veins or nerves" (that would conform to Peninsular Malaysian material, not the taxon from Silhet). The next oldest name, *Fagraea crassifolia*, is used as there is no conflict of material or description. The range of Thai material cited under *Fagraea obovata* by Craib & Kerr (1951) needs to be critically assessed; the Peninsular Thai material represents *F. splendens*.

5. *Fagraea curtisii* King & Gamble

J. As. Soc. Beng. 74 (2) (1908) 605; Ridley, Fl. Malay. Pen. 2 (1923) 417; Craib & Kerr, Fl. Siam. Enum. 3 (1951) 55; Leenhouts, Fl. Males. I, 6 (2) (1962) 332; Kochummen, Tree Fl. Malaya 2 (1973) 271; Griffin & Parnell, Fl. Thailand 6 (3): 197–205. TYPE: *Curtis 1676*, Langkawi, Teluk Woh (holo K; iso SING).

Fagraea curtisii* var. *curtisii

Small tree or hemi-epiphyte, usually to 13 m tall or 10 m high or more on trees; trunk/stems to c. 30 cm diameter; bark smooth, creamy to grey-brown. **Leaves** elliptic to subobovate; (8.5–)10–22(–28) cm long, (3–)5–7.5(–9.2) cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* 4–5 pairs if visible, upper side obscure, lower side faint and immersed in the lamina to obscure; *tertiary and higher-order veins* faint to obscure; petioles (1.3–)2–3(–3.5) cm long, 2–3(–4) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–3 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a solitary flowered or 2- to few-flowered cyme, the whole about 10–20 mm long; *peduncle* indistinct or to 7 mm long, to 5 mm diameter; inflorescence *rachis* 10–12 mm long, 4–5 mm diameter, with 0–1 pair of primary branches; basal primary *branch pairs* 8–20 mm long, 3–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* indistinct or to 5 mm long, to 5 mm diameter; *floral bracts* small, acute, 3–5 mm long, located below the calyx; *calyx* 17–33 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 9–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, (12–)17–20 mm long, 10–20 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); light orange to cream to white; *lower subcylindrical part of the corolla tube* 17–25 mm long, 9–10 mm wide basally, *upper flared part* of the tube slightly inflated, 18–30 mm long, 30–32 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 35–40 mm long, 25–30 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 32–40 mm long, protruding to c. 10 mm from the corolla mouth; *anthers* versatile, hastate, 17–20 mm long, 2–3 mm wide, each anther sac somewhat ellipsoid; *style* not seen [*fide* Griffin & Parnell (1997): ovary and style c. 6 cm long]; *stigma* not seen [*fide* Leenhouts (1962): stigma peltate, c. 2.5 mm across]. **Infructescence** peduncle indistinct or to 7 mm long, 5–7 mm thick. **Fruit** broadly ovoid to subglobose, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 35–45 mm long, 20–25(–36) mm diameter; the base loosely surrounded to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–3 mm long, 1–2 mm wide; testa surface areolate.

DISTRIBUTION. Malay Peninsula (including peninsular Thailand, the extreme northwest and west-coast areas of Peninsular Malaysia).

HABITAT. Restricted to limestone outcrops and their vicinity.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kedah. Langkawi, Pulau Dayang Bunting, *Corner SFN 38129*, FR, 13 Nov 1941 (KEP, SING); Langkawi, Pulau

Langgon, *Imin FRI 68437*, FR, 4 Nov 2009 (KEP, L, SAN, SING), Pulau Langgon, Tanjong Dalam, *Boey 528*, FR, 4 Nov 1971 (KLU); Langkawi, Pulau Segai, *Haniff SFN 15584*, FR, Feb 1911 (SING); Langkawi, Pulau Timun, *Chia & Chin LT 372*, FR, 13 Nov 1979 (KLU), *Henderson SFN 29109*, FR, 24 Nov 1934 (SING); Langkawi, Pulau Timun, south coast, on limestone, *Whitmore FRI 15103*, FR, 16 Dec 1969 (KEP, SING); Langkawi, Pulau Timun, sandy beach, *Sim B-112*, FR, 13 Nov 1979 (KLU); Langkawi, Tanjong Sirie, *Curtis 1696*, FB, FL, Sep 1890 (SING); Langkawi, Telok Apau, *Haniff & Nur SFN 7089*, FR, 17 Nov 1921 (SING); Langkawi, Teluk Woh, *Curtis 1676*, Aug 1888, FL (K), FB (SING). **Perak.** Gua Puteri limestone, 500 ft [152 m] alt, *Samsuri & Mahmud SA 628*, FR, 13 Mar 1971 (KLU, SING); Kuala Kangsar, Sg. Siput, rockface near cave mouth, *Tan FRI 81814*, FR, 27 Jan 2015 (BKF, K, KEP, SAN, SING); Lenggong, Kampong Gelok, Gua Putri limestone, 100 m alt, *Chin 967*, leafy twig, 13 Mar 1971 (KLU); Padang Rengas, Gua Pondok limestone, 300 m alt, *Chin 910*, FR, 12 Mar 1971 (KLU). **PENINSULAR THAILAND.** Phuket, Trang, Kao Kao, *Rabil 276*, FR, 1929 (BK).

Fagraea curtisii* var. *calcarea (M.R.Hend.) K.M.Wong & M.Sugumaran, **comb. & stat. nov.**

Basionym: *Fagraea calcarea* M.R.Hend., Gard. Bull. S.S. 7 (1933) 113, t. 28B; Leenhouts, Fl. Males. I, 6 (2) (1962) 332; Kochummen, Tree Fl. Malaya 2 (1973) 271. TYPE: *Henderson SFN 25036*, Pahang, Bukit Chintamani (holo SING; iso K).

The only clear morphological difference between this variety and *Fagraea curtisii* var *curtisii* is the larger floral bracts in this variety (7–18 mm long) that are rounded and apically clasping the calyx base. The floral bracts in *Fagraea curtisii* var. *curtisii* are smaller (3–5 mm long), acute and not conspicuously overlapping the calyx.

DISTRIBUTION. Malay Peninsula (known only from Kelantan and Pahang states in Peninsular Malaysia).

HABITAT. Restricted to limestone outcrops and their vicinity.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. Gua Musang, *Teo & Wintz KL 4819*, FL, 7 Oct 1998 (KEP), Gua Musang, *Boey 298*, FB, 18 Aug 1971 (KLU); Sungai Nenggiri, Gua Jaya, limestone, *Whitmore FRI 4243*, FB, 27 Jul 1967 (KEP, SING); Ulu Kelantan, Gua Musang, path to Sungai Ketil, *Shah & Ali MS 2855*, FR, 30 Jan 1973 (SING). **Pahang.** Bukit Chintamani, limestone cliff, *Henderson SFN 25036*, FB, FL, 4 Oct 1931 (K, SING); Merapoh, Gua Layang limestone, 100 m alt, *Chin 1524*, FB, 13 Aug 1971 (KLU).

Fagraea curtisii var. *calcarea* is found on the Pahang and east coast limestones, whereas the typical variety is recorded from limestone in the region including Peninsular Thailand,

the extreme northwest of Peninsular Malaysia, Kedah and Perak, i.e., west of the Peninsular Malaysian Main Range.

6. *Fagraea fastigiata* Blume

Rumphia 2 (1838) 30, t. 76 f. 1; Leenhouts, Fl. Males. I, 6 (2) (1962) 324; Kochummen, Tree Fl. Malaya 2 (1973) 270. TYPE**:** *Hasselt*, *s.n.*, Lesser Sunda Islands (holo L: acc. no. 908127-218 & barcode L0005009).

Fagraea fastigiata sensu Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 322 pro parte, tantum speciminia Javanica.

Fagraea fastigiata sensu Ridley, J. Str. Br. R. As. Soc. 30 (1897) 167 pro parte, excl. *Ridley 7552* (= *F. crenulata* Maingay ex Clarke).

Hemi-epiphyte, up to 17 m high or more on trees; stems to c. 10 cm diameter; bark smooth, grey-brown. **Leaves** elliptic to suborbicular; (10–)18–23(–26) cm long, (4.5)8.5–12(–13.5) cm wide; *base* narrowly decurrent with 1–2 mm broad wings towards the petiole base; *apex* acute; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* prominent and sometimes keeled upon drying on both sides; *secondary veins* 3–5 pairs, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* obscure; petioles 5–10 mm long, 3–5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 2–3 mm high adaxially; *auricles* developing above the petiolar sheath, continuous from the lamina base, forming small rounded lobes 4–7 mm broad. **Inflorescence** terminal, a few- to many-flowered cyme, the whole about 6–7 cm long; *peduncle* indistinct; inflorescence *rachis* 6–7 cm long, 2–4 mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* (3.5–)5–6 cm long, 2–3 mm diameter and rebranched to 1–2 orders. **Flower** bisexual; *pedicels* c. 5 mm long, c. 2 mm diameter; *floral bracts* small, acute, c. 3 mm long, located below the calyx; *calyx* 5–6 mm long (from the base to the lobe apices), glabrous, lenticellate, *calyx cup* 4–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, apically clasping the corolla tube, 4–5 mm long, 3–4 mm wide, margins glabrous, base not auriculate; *corolla* not seen [*fide* Leenhouts (1962): corolla tube widely funnel-shaped, 3 cm long]; *stamens* not seen [*fide* Leenhouts (1962): anthers ovate-lanceolate, 7 mm long]; *style* not seen. **Infructescence** peduncle indistinct. **Fruit** broadly ovoid, *apex* rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 20–30 mm long, 20–28 mm diameter; the base loosely surrounded by the erect calyx lobes. **Seeds** numerous; subovoid; 2–2.5 mm long, 1–2 mm wide; testa surface areolate.

DISTRIBUTION. Java, Malay Peninsula.

HABITAT. Lowland rain forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. SE border near Trengganu, Ulu Sungai Lebir Kechil, 500 m alt, *Cockburn FRI 7121,* FR, 17 Sep 1967, (KEP, SING), *Whitmore FRI 4386* (KEP, SING). **Perak.** Ijok Forest Reserve, *Sow KEP 48648*, FB, 11 Feb 1939 (KEP). **LESSER SUNDA ISLANDS** (INDONESIA). *Hasselt s.n.*, FB, no date (L: acc. no. 908127-218 & barcode L0005009).

This species is distinctive by its leaf base, which attenuates towards the petiole base and forms rounded auricles just above the petiolar sheath. In the other species that have auricular structures associated with the leaves, the leaf base is either not completely decurrent to the petiole base or, if decurrent, the auricles are formed at the petiole base below the petiolar sheath.

7. *Fagraea fraserensis* K.M.Wong & M.Sugumaran, **sp. nov.**

Inter species malayenses valde peculiaris basi lobis calycis auriculatis.

TYPE: *Sugumaran & Low SM 163*, Pahang, Fraser's Hill, beside path to Jeriau waterfall, 12 Oct 2007 (holo KLU).

(Fig. 5A, 9, 10)

Fig. 9. Habit of flowering *Fagraea fraserensis*. (Photo credit: M. Sugumaran)

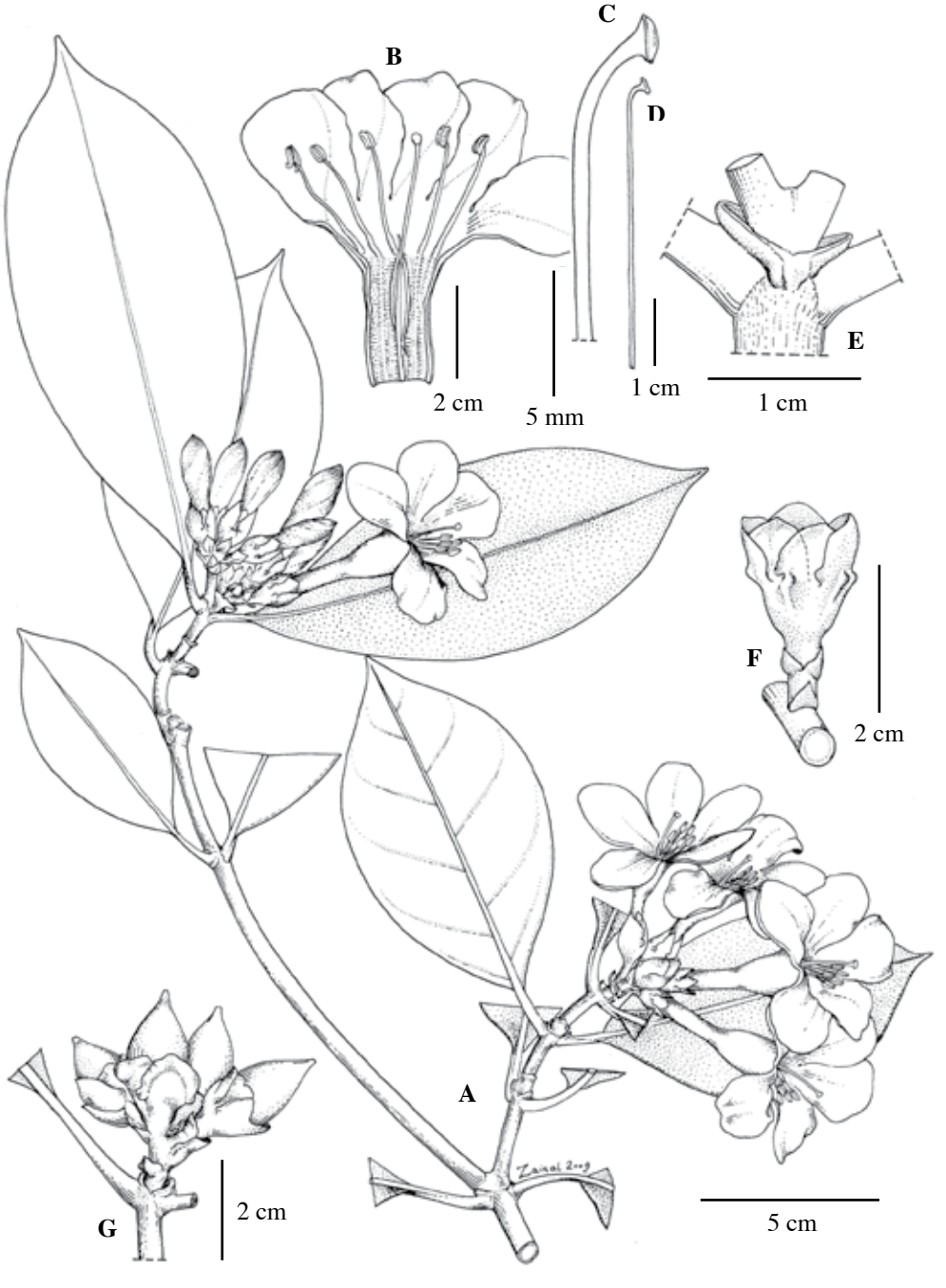

Fig. 10. *Fagraea fraserensis*. **A**. Leafy branch with inflorescences. **B**. Sectioned corolla showing attachment of stamens. **C** & **D**. Stigma. **E**. Portion of stem node with ligules at the adaxial side of petiole bases. **F**. Calyx with basally auriculate lobes. **G**. Branch with an infructescence. A–F from *Sugumaran* & *Low SM 163* (holotype, KLU). G from *Sugumaran et al*. *SM 164* (KLU). (Drawing by Zainal Mustafa)

Hemi-epiphyte (probably also occasionally a shrub or small tree), usually 1–2 m high (or probably more) on trees; trunk/stems to c. 10 cm diameter; bark smooth, dark-brown. **Leaves** elliptic to subobovate; (6.8–)10–17(–19) cm long, (3.3–)5.5–7.6 cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* sunken above, prominent below; *secondary veins* 5–7 pairs if visible, otherwise often obscure on both sides; tertiary and higher-order veins obscure; petioles 20–30 mm long, 2–4 mm thick, petiolar sheaths not fused along the interpetiolar median, each developing a scale-like ligule 1–2 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 1.6–1.8 cm long; *peduncle* indistinct or to 6 mm long, to 4 mm diameter; inflorescence *rachis* 9–18 mm long, 3–4 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 5–16 mm long, 3–4 mm diameter and rebranched to 1 order, more distal branch pairs not so. **Flowers** fragrant; bisexual; *pedicels* indistinct or to 4 mm long, to 4 mm diameter; *floral bracts* small, acute, 3–4 mm long, located below the calyx; *calyx* 10–12 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 4–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 8–10 mm long, 8–10 mm wide, margins glabrous, base auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 16–18 mm long, 4–5 mm wide basally, *upper flared part* of the tube slightly inflated, 10–18 mm long, 13–18 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 9–10 mm long, 8–10 mm wide, overlapping to the right; *stamens* 5, inserted (at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube); *filaments* 20–24 mm long, protruding to 6–10 mm from the corolla mouth; *anthers* versatile, hastate, 4–5 mm long, 2–3 mm wide, each anther sac somewhat ellipsoid; *style* 35–42 mm long, protruding to 6–9 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–1.5 mm across. **Infructescence** peduncle indistinct or to 5 mm long, to 4 mm thick. **Fruit** narrowly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 20–25 mm long, 15–18 mm diameter; the base loosely surrounded to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–3 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Known only from Peninsular Malaysia (Fraser's Hill area).

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Pahang. Fraser's Hill, beside path to Jeriau Waterfalls, *Sugumaran SM 79*, FR, 3 Nov 2006 (KLU), *Sugumaran et al. SM 164*, FR, 3 Jan 2008 (KLU), beside path to Jeriau Waterfalls, 3°43'N 101°42'E, 970 m, *Sugumaran & Low SM 163*, FB, FL, FR, 12 Oct 2007 (KLU), waterfall, epiphyte, *Kiew 3320*, FL, 9 Sep 1991 (SING).

The auriculate bases of the calyx lobes are highly distinctive and appear to be unique among Malay Peninsula species of *Fagraea*. This species also differs from most other *Fagraea* species because of the faint but still discernable secondary veins in the dried leaves. The only other Malay Peninsula species with distinct leaf veins in dried material are *Fagraea auriculata*, *F. imperialis*, *F. kinghamii* (where flowers are very large in comparison, and large leaf-stalk auricles are present in the former two species), *F. fastigiata* (with leaf blades bearing basal auricles), *F. oblonga* (more pairs of secondary veins, typically more branched inflorescences), *F. renae* (more branched inflorescences), and *F. ridleyi* (with more robust inflorescence axes, 4–6 mm diameter, and even larger calyx lobes, 14–18 mm long).

In the exauriculate leaf-stalk bases, indistinct leaf veins, and relatively small, non-involucrate flowers in small, little-branched cymes, *Fagraea fraserensis* approaches *F. splendens*, but its inflorescence has distinct 1st order branches 3–12 mm long (in *F. splendens* they are only 3–4 mm long). The larger calyces (with lobes 8–10 mm long, 8–10 mm broad) also distinguish it from *Fagraea splendens* (lobes 4–6 mm long and 4–6 mm broad). The large, thin calyx lobes wrap tightly around the corolla base or young fruit, giving a spindle-shape to the whole calyx structure, compared to the cup-shaped structure in *Fagraea splendens*, where the calyx lobes are held loosely erect. Also, the fruits of *Fagraea fraserensis* are narrowly ovoid with a long attenuate apex when dry, whereas those of *F. splendens* maintain a broad ellipsoid shape with rounded apex. Other species with similar corolla sizes and generally infundibular shapes, such as *Fagraea littoralis* and *F. oblonga*, are also different in their non-auriculate calyx lobes, among other characters.

ETYMOLOGY. Named after Fraser's Hill, where this species was discovered.

8. *Fagraea gardenioides* Ridl.

J. Fed. Mal. St. Mus. 5 (1914) 42. TYPE: *Robinson s.n.*, 22 Jan 1913, Selangor, Gunung Mengkuang (holo K; iso SING).

Fagraea gardenioides sensu Leenhouts, Fl. Males. I, 6 (2) (1962) 331 pro parte, excl. ssp. *borneensis* Leenhouts (= *F. havilandii* K.M.Wong & Sugau).

Fagraea gardenioides sensu Kochummen, Tree Fl. Malaya 2 (1973) 270 pro parte, excl. speciminia origine 'Borneo'.

(Fig. 1D, 4, 11)

Small tree or hemi-epiphyte, usually to 4 m tall or 2 m high or more on trees; trunk/stems to c. 5 cm diameter; bark smooth, grey to dark-brown. **Leaves** broad elliptic to obovate; (7.5–)9–13(–15.3) cm long, (4–)5–6(–7.6) cm wide; *base* cuneate to not conspicuously decurrent with up to 1 mm-broad wings towards the petiole base; *apex* rounded; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous,

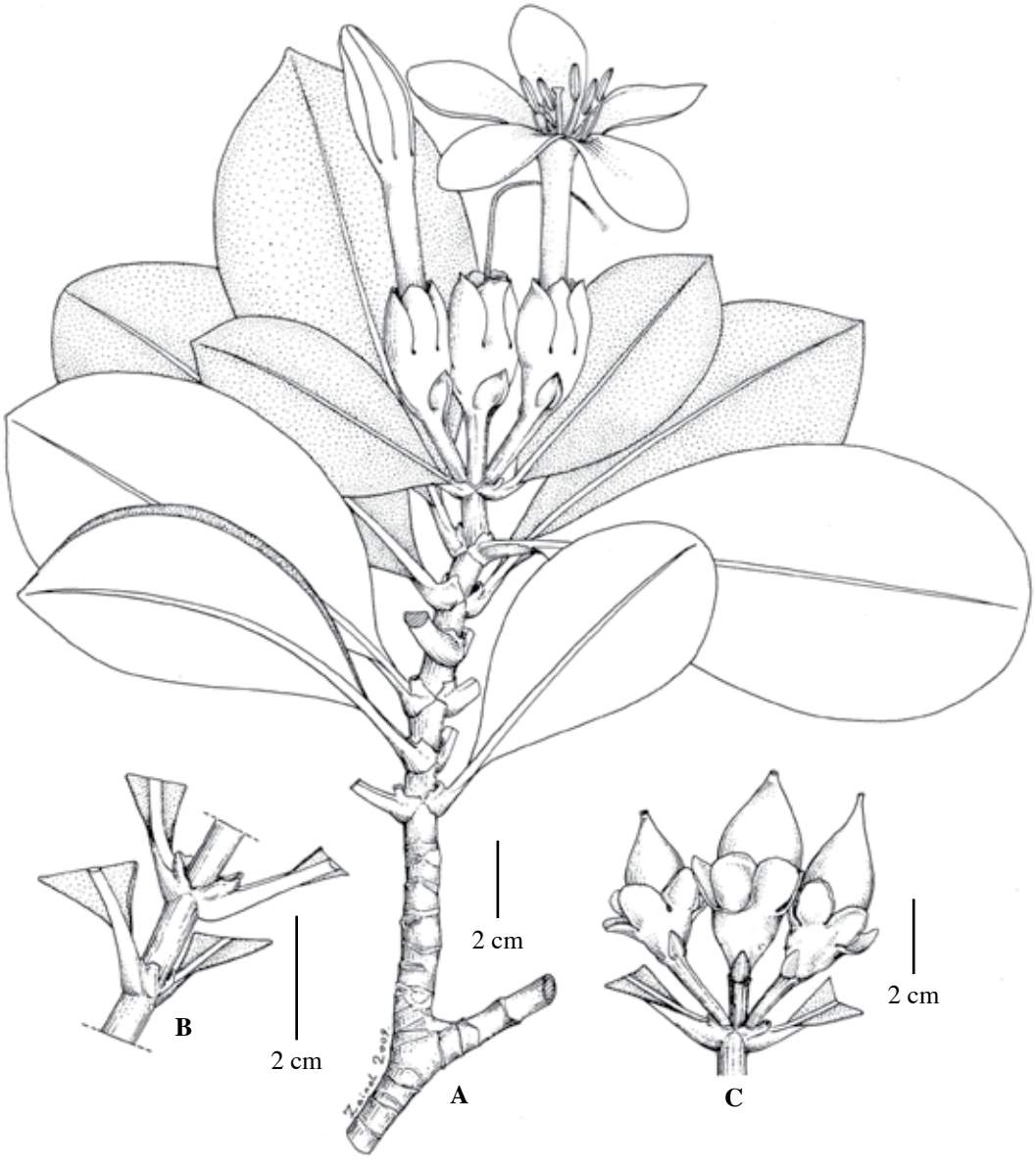

Fig. 11. *Fagraea gardenioides*. **A**. Leafy branch with an inflorescence. **B**. Portion of stem with ligules on the adaxial side of the petiole bases. **C**. An infructescence. All from *Poore 749* (KLU). (Drawing by Zainal Mustafa)

lower surface relatively smooth; *midrib* prominent on both sides towards the leaf base but flat to sunken nearer the leaf apex; *secondary veins* obscure on both sides; *tertiary and higher-order veins* obscure; petioles (3–)7–12(–15) mm long, 2–4 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 3–4 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 1- to few-flowered cyme, the whole about 1–2.2 cm long; *peduncle* indistinct; inflorescence *rachis* 1–2.2 mm long, 4–6 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 15–21 mm long, 3–5 mm diameter and not rebranched. **Flowers** fragrant; bisexual; *pedicels* 5–6 mm long, 4–5(–7) mm diameter; *floral bracts* small, acute, 7–10 mm long, located below the calyx; *calyx* 22–30 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 10–13 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 14–20 mm long, 10–15 mm wide, margins glabrous, base not auriculate; *corolla* slender trumpet shaped (tubular and very gradually widening towards the apex); cream to white; *corolla tube* 40–53 mm long, 8–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 30–42 mm long, 14–25 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 20–27 mm long, protruding to 12–17 mm from the corolla mouth; *anthers* versatile, hastate, 8–10 mm long, 3–4 mm wide, each anther sac somewhat ellipsoid; *style* 50–55 mm long, protruding 2–10 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 3–4 mm across. **Infructescence** peduncle indistinct or to 6 mm long, to 5 mm thick. **Fruit** narrowly to broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 30–40 mm long, 13–20 mm diameter; the base loosely to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–3 mm long, 1–2 mm wide; testa surface areolate.

DISTRIBUTION. Malay Peninsula (Main Range mountains, Gunung Bubu and Gunung Korbu).

HABITAT. Upper reaches of lower montane forest and upper montane mossy forest, common in stunted vegetation on ridges.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Pahang. Cameron Highlands, Gunung Brinchang, 6000 ft [1829 m] alt, *Poore 749*, FL, 3 Jul 1961 (KLU), 6666 ft [2032 m] alt, *Ng FRI 5975*, FR, 3 Mar 1968 (K, KEP, SING), 6500 ft [1981 m] alt, *Stone 7251*, FB, FL, 1 Aug 1967 (KLU); Fraser's Hill, Pine Tree Hill, *Symington KEP 29482*, leafy twig, 14 Apr 1933 (KEP), 4750 ft [1448 m] alt, *Burkill, Shah & Noor HMB 2384*, FL, 18 Aug 1960 (SING), 4780 ft [1457 m] alt, *Purseglove P 4231*, FB, FL, 19 Apr 1955 (SING); Pahang/Selangor border, Gunung Ulu Kali, *Imin FRI 66475*, FR, 3 Feb 2010 (K, KEP, L, SAN, SING), summit of Ulu Kali, 5000–6000 ft [1524–1829 m] alt, *Soepadmo HUM 9002*, FB, FR, 4 Apr 1968 (KLU); Gunung Ulu Kali, 5500 ft [1676 m] alt, *Stone 14071*, FL, 31 Mar 1979 (KLU), 5600

ft [1707 m] alt, *Siew 144*, FL, 18 Jun 1977 (KLU). **Perak.** Gunung Bubu summit, *Symington KEP 30843*, FB, FL, 8 Apr 1933 (KEP); Gunung Korbu, 5500–7000 ft [1676–2134 m] alt, *Symington KEP 32235*, FL, 22 Jul 1933 (KEP, SING); Gunung Raya, 5700 ft [1737 m] alt, *Strugnell & Tachun KEP 45890*, FB, 31 Jan 1938 (KEP). **Selangor.** Gunung Mengkuang, 5000–5600 ft [1524–1707 m] alt, *Robinson s.n.*, FL, 22 Jan 1913 (K, SING); Ulu Selangor, Genting Highlands, G. Genting Chin-Chin, 1680 m alt, 3°27'N 101°47'E, *Chua et al. FRI 40798*, FB, FL, 6 May 1999 (KEP); Ulu Selangor, Gunung Moyang, 5500 ft [1676 m] alt, *Symington KEP 56665*, FR, 3 Nov 1940 (KEP).

Leenhouts (1962) placed Sarawak material as a subspecies (ssp. *borneensis*) of this species, but that has been distinguished as a different species, *Fagraea havilandii* by Wong & Sugau (1996).

9. *Fagraea imperialis* Miq.

Fl. Ind. Bat. 2 (1857) 372; Wong & Sugau, Sandakania 8 (1996) 68. TYPE**:** *Teysmann HB 599*, Sumatra, Siboga (iso L: acc. no. 908127-58 & barcode L0004930).

Fagraea auriculata auct. non Jack (1822), pro parte, quoad *F. imperialis* Miq. in syn.: Clarke in Hooker f., Fl. Brit. Ind. 4 (1885) 83; King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 605; Ridley, Fl. Malay. Pen. 2 (1923) 416; Leenhouts, Fl. Males. I, 6 (2) (1962) 326.

(Fig. 1C, 5D, 12, 13, 14)

Fig. 12. *Fagraea imperialis* (*Sugumaran et al.* SM 230) demonstrated by field assistant Yusuf. (Photo: M. Sugumaran)

Fig. 13. *Fagraea imperialis*. **A.** (From left) Floral buds, open flower, young fruit and leaf. **B.** Inflorescence with flower buds flanking a young fruit in the middle of the cyme. (Photo credits: M. Sugumaran)

Fig. 14. Fresh shoots of *Fagraea imperialis* (left) and *F. auriculata* compared. (Photo: M. Sugumaran)

Hemi-epiphyte, up to 25 m high or more on trees; stems to c. 15 cm diameter; bark smooth, grey-brown; branch internodes typically with a pair of keels 2–5 mm broad along the interpetiolar region. **Leaves** elliptic to subovate; (5–)25–34(–38) cm long, (4–)10–13(–17) cm wide; *base* narrowly decurrent with (0.5–)1–2 mm-broad wings towards the petiole base; *apex* acute to slightly pointed; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* slightly prominent above, more prominent below with a low median keel upon drying; *secondary veins* 5–7(–8) pairs, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* faint; petioles 5–15(–20) mm long, 5–7(–9) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–2(–4) mm high adaxially; *auricles* developing below the petiole base distinct from the lamina base, forming broad rounded reflexed lobes (0.6–)1–1.8(–2) cm broad (in fresh materials measuring up to 3 cm broad). **Inflorescence** a 2- to few-flowered cyme, the whole about 1.5–3.5(–5) cm long; *peduncle* indistinct; inflorescence *rachis* 1.5–3.5(–5) cm long, 1–1.5 cm diameter, with 1(–2) pairs of primary branches; basal primary *branch pairs* 2–4 cm long, 1–1.2 cm diameter and not rebranched. **Flowers** very fragrant; bisexual; *pedicels* inconspicuous; *floral bracts* conspicuous, (1–)2–3(–3.5) cm long, rounded, these and a pair

of conspicuous inflorescence-branch bracts forming a loose involucre around the calyx; *calyx* 6.5–7 cm long (from the base to the lobe apices), glabrous, not lenticellate, *calyx cup* 2.5–3(–4) cm diameter, *calyx lobes* 5, broad-elliptic to rounded, (4.5–)5–5.5(–5.7) cm long, (3–)3.4–3.7(–4) cm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* (4–)9–10 cm long, (1.5–)2.5–3 cm wide basally, *upper flared part* of the tube slightly inflated, 5–6 cm long, 6.5–7.5(–8) cm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 6.5–7.5(–8) cm long, 4.5–5.5(–7) cm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* (5.5–)8–9 cm long, protruding to (0.5–)2.7–4 cm from the corolla mouth; *anthers* versatile, hastate, 1.5–1.7 cm long, c. 1 cm wide, each anther sac somewhat ellipsoid; *style* 9–10(–11.5) cm long, slightly protruding to c. 5 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, 4–6 mm across. **Infructescence** peduncle indistinct. **Fruit** narrowly ellipsoid, *apex* rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to c. 9.5 cm long, c. 4.5 cm diameter; the base tightly clasped by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2.5–3 mm long, 2–2.2 mm wide; testa surface areolate.

DISTRIBUTION. Sumatra, Malay Peninsula.

HABITAT. Swamp forests and lowland terrestrial forests from coastal to inland sites.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Locality unknown, *Teruya 2421*, FL, Jul–Aug 1933 (SING). **Kelantan.** W Kelantan, Sungai Perias at Kuala May, *Whitmore FRI 4164*, leafy twig only, 21 Jul 1967 (KEP); Ulu Kelantan, Gua Musang, summit of limestone hill, *Ng FRI 5563*, leafy twig only, 22 Jun 1967 (KEP). **Pahang.** Taman Negara, Batu Subuh, summit, *Kiew 1485*, FR, 8 Oct 1984 (KEP, SING); Taman Negara, Gua Luas, summit, *Ng FRI 27054*, leafy twig only, 4 Mar 1977 (KEP). **Perak.** Bubu Forest Reserve, *Symington FMS 28571*, FB, 30 Mar 1933 (SING); Gunung Bubu, banks of Sungai Kenas at dam, 250 ft [76 m] alt, *Whitmore FRI 963*, leafy twig only, 15 Feb 1967 (KEP); Tasik Temenggor, Sungai Gadong, *Sugumaran et al. SM 230*, FL, 29 Jul 2008 (KLU), *SM 238*, FB, FL, 5 Aug 2008 (KLU). **Selangor.** Weld Hills F.R., (*Collector name indistinct*) *CF 908*, FB, FL, 12 Aug 1916 (KEP). **SUMATRA** (INDONESIA). Atjeh, Gunung Leuser Nature Reserve, *deWilde & deWilde-Duyfjes 14047*, FR, 5 Jul 1972 (SING), Oneng Oneng, 1180 m alt, *Steenis 6583a*, leafy branch only, no precise date, 1934 (SING); Siboga, *Teysmann HB 599*, FL (drawing), no date (L).

This species has often been confused with *Fagraea auriculata* because of the development of large, leathery, rounded auricles at the petiole bases and the generally big, distinctive creamy flowers. However, the larger flowers of *Fagraea imperialis* and other characters adequately distinguish the two.

10. *Fagraea kinghamii* K.M.Wong & M.Sugumaran, **sp. nov.**

Fagraeae auriculatae similis sed floribus solitariis, bracteis floralibus magnis et distributione montana differt.

TYPE: *Henderson SFN 23289*, Pahang, Cameron Highlands, 4800 ft [1463 m] alt, 1 Apr 1930 (holo SING, iso KEP).

Fagraea auriculata auct. non Jack (1822): Leenhouts, Fl. Males. I, 6 (2) (1962) 331 pro parte, tantum speciminia montium peninsulae Malayensis sub 'ssp. auriculata', e.g. *Henderson SFN 31081*; Kochummen, Tree Fl. Malaya 2 (1973) 270 pro parte, tantum speciminia montium peninsulae Malayensis; Wong & Sugau, Sandakania 8 (1996) 51 pro parte, incl. Fig. 16, quoad *Symington KEP 36092*, *Whitmore FRI 12214*, *15551*.

(Fig. 15)

Small tree or hemi-epiphyte, usually to 5 m tall or 5 m high or more on trees; trunk/stems to c. 5 cm diameter; bark smooth to shallowly fissured, grey-brown; branch internodes often developing a pair of low ridges or keels up to 1 mm high in the inter-petiolar region. **Leaves** elliptic to subobovate; (7.5–)13–16(–22) cm long, (3.8–)5–6.2(–7.2) cm wide; *base* narrowly decurrent with 1–2 mm broad wings towards the petiole base; *apex* shortly pointed; *margin* entire, recurved in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below and sometimes developing a low median keel upon drying; *secondary veins* 5–7 pairs, upper side faint and immersed in the lamina, lower side faint and immersed in the lamina; *tertiary and higher-order veins* obscure; petioles (1–)5–7(–17) mm long, (2–)3–4 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 2–3 mm high adaxially; auricles developing below the petiolar base, distinct from the lamina base, forming narrow rim-like structures (2–)3–5(–7) mm broad. **Inflorescence** terminal, consisting of a solitary flower, the whole about 5–15 mm long; *peduncle* indistinct or to 5–10(–15) mm long, to 8 mm diameter; the rachis internode between peduncle and pedicel indistinct. **Flowers** very fragrant; bisexual; *pedicels* indistinct or to 10 mm long, to 10 mm diameter; *floral bracts* small to large, rounded, (7–)15–30(–35) mm long, typically overlapping the calyx base and forming a loose involucre around the calyx together with a pair of expanded inflorescence bracts (when the latter are present); *calyx* (30–)35–50 mm long (from the base to the lobe apices), glabrous, lenticellate, *calyx cup* (10–)15–25 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 23–35(–40) mm long, 17–25 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 22–30 mm long, 10–17 mm wide basally, *upper flared part* of the tube slightly inflated, 23–30 mm long, 28–40(–50) mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 32–50(–60) mm long, 30–37 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 40–50 mm long,

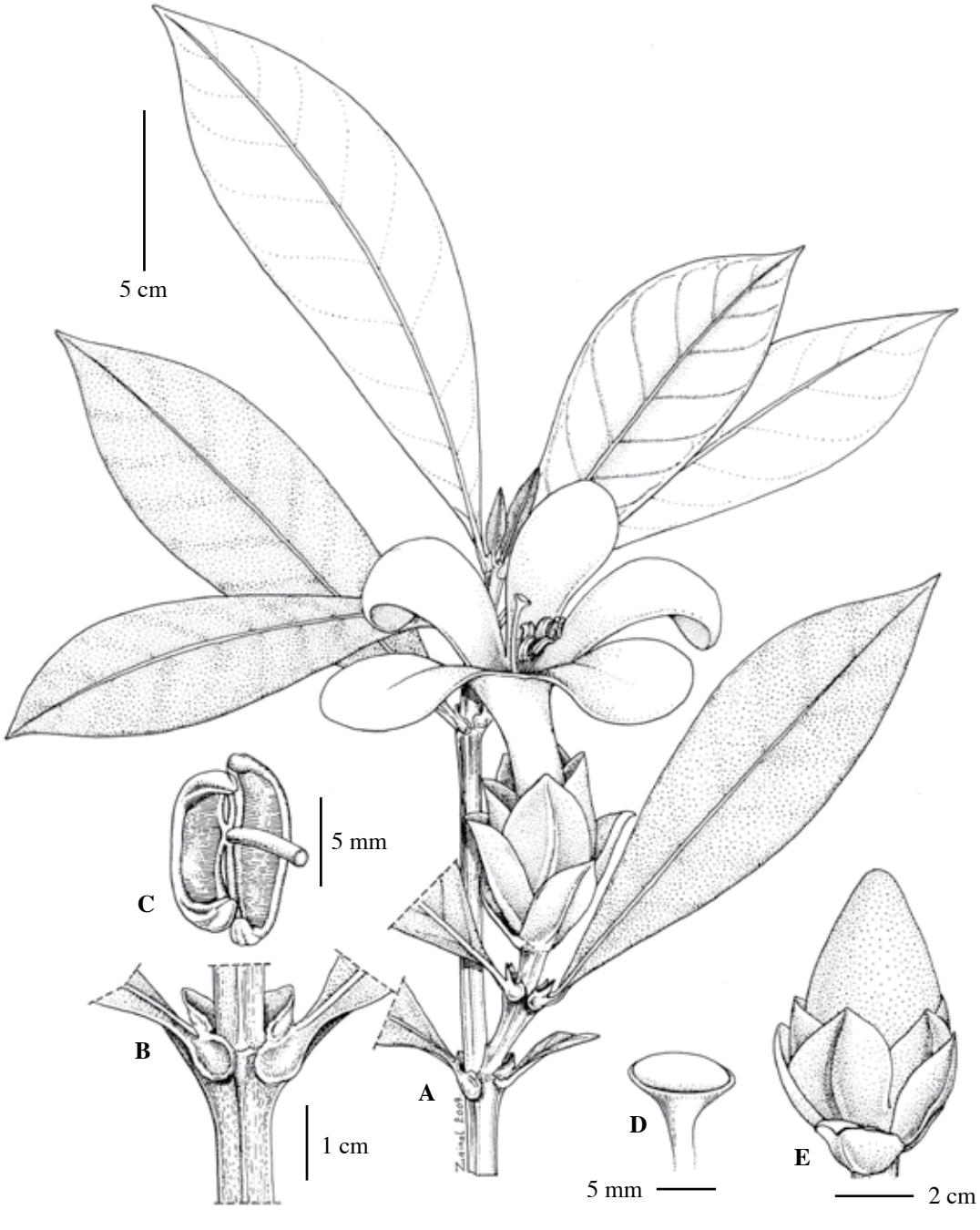

Fig. 15. *Fagraea kinghamii*. **A**. Leafy branch with a solitary flower. **B**. Portion of stem with ligules on the adaxial side of the petiole bases, which also develop auricles. **C**. Ventral view of anther. **D**. Peltate stigma. **E**. Fruit basally enveloped by the calyx and involucre of floral bracts. A, C & D from *Hislop* s.n. (SING), B & E from *Whitmore FRI 12214* (KEP). (Drawing by Zainal Mustafa)

protruding to 17–20 mm from the corolla mouth; *anthers* versatile, hastate, 8–10 mm long, 5–6 mm wide, each anther sac somewhat ellipsoid; *style* 65–70 mm long, protruding to 10–22 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive, the whole sometimes resembling a subpeltate structure c. 8 mm across. **Infructescence** peduncle indistinct or to 5 mm long, to 7 mm thick. **Fruit** narrowly to broadly ovoid, *apex* conspicuously attenuated; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 45–55(–60) mm long, 20–35 mm diameter; the base tightly clasped by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, c. 1.5 mm wide; testa surface areolate.

DISTRIBUTION. Malay Peninsula.

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. **Pahang.** Bentong, Fraser's Hill, *Kochummen KEP 98161*, FB, 11 Dec 1961 (KEP, SING); Cameron Highlands, *Symington KEP 36092*, FL (L), FR (K, KEP, SING), 4800 ft [1463 m] alt, *Henderson SFN 23289*, FL, FR, 1 Apr 1930 (KEP, SING); Cameron Highlands, Mardi Trail 7, 1450 m [442 m] alt, *Garcia FRI 32703*, FR, 5 Apr 1988 (KEP); Cameron Highlands, route 7 to G. Beremban, 1500 m alt, *Perumal et al. FRI 41624*, FB, 3 Mar 1994 (KLU); Gunung Benom, main NE ridge, boundary of Krau Game Reserve, 4800 ft [1463 m] alt, *Whitmore FRI 3328*, FR, 20 Mar 1967 (KEP, SING); Selangor border, Ulu Kali, *Whitmore FRI 15551*, FL, 2 Oct 1970 (K, KEP, L, SING), 5000 ft [1524 m] alt, *Whitmore FRI 12214*, FL, FR, 24 Aug 1968 (KEP), FB, FR (SING); Ulu Telom, *Jaamat KEP 27295*, FR, 29 Aug 1931 (KEP). **Perak.** Birch's Hill, *Fox s.n.*, FR, Oct 1899 (SING), *Burkill & Haniff SFN 12643*, FR, 4 Mar 1924 (SING), *SFN 12861*, FR, 29 Feb 1924 (SING); near the Cottage, *Fox* s.n., FB, FL, Dec 1899 (SING); Taiping Hill, 4050 ft [1234 m] alt, *Haniff & Nur SFN 2344*, FR, 14 Feb 1917 (SING), 4100 ft [1250 m] alt, *Henderson SFN 11805*, FR, 4 Mar 1924 (SING). **Terengganu.** Gunung Padang, *Hislop s.n.*, FL, Jul 1952 (SING), 4000 ft [1219 m] alt, *Moysey & Kiah SFN 31081*, FB, FL, Jun 1937 (SING).

This is easily distinguished from both *Fagraea auriculata* and *F. imperialis* by its always solitary flowers, smaller leaves and montane provenance; also in its large floral bracts (different from *F. auriculata*, similar to *F. imperialis*) and smaller flowers (different from the very big flowers of *F. imperialis*, just slightly smaller than those of *F. auriculata*; see discussion under *F. auriculata* for a more detailed comparison of these three species).

Both this and the Bornean *Fagraea resinosa* develop large, rounded floral bracts around the calyx. Both also have a slight auricular structure at the petiole bases. However, this species has a broadly infundibular corolla, unlike the subsalverform corolla with a long narrow tube in *Fagraea resinosa*.

ETYMOLOGY. James Jay Kingham (b. 1936) is a Malaysian horticulturist *par excellence* specially interested in native forest species, who made substantial donations of nursery-raised introductions from Malaysian forests to the University of Malaya's Rimba Ilmu Botanic Garden. His active interest in bringing forest species into cultivation in a systematic manner has encouraged many agencies throughout the country to use native species to augment the conservation potential of their projects, and led to broader possibilities for *ex situ* conservation of this biodiversity.

11. *Fagraea larutensis* M.Sugumaran, **sp. nov.**

Fagraeae crassifoliae similis sed calycibus minoribus (17–18 mm longis, 5–6 mm latis), lobis corollae minoribus (15–16 mm longis, 9–10 mm latis) et tubo corollae breviore differt.

TYPE: *King's Collector 7518*, Perak, Larut, 300–500 ft [91–152 m] alt, Apr 1885 (holo SING).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *Sinclair & Kiah SFN 38660* & *Burkill & Haniff 12585*.

Fagraea obovata auct. non Wallich ex Roxburgh (1824): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 606 pro parte, quoad *King's coll. 7578*.

(Fig. 16)

Scrambler or hemi-epiphyte, 10–30 m high or more on trees; trunk/stems to c. 10–15 cm diameter; bark smooth, grey-brown. **Leaves** elliptic; (6.5–)8–11(–12) cm long, (2–)3–5 cm wide; *base* cuneate, not decurrent; *apex* short-cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* 4–5 pairs if visible, otherwise obscure on both sides; *tertiary and higher-order veins* obscure; petioles 13–20 mm long, 1–2 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 15–25 mm long; *peduncle* indistinct; inflorescence *rachis* c. 10 mm long, c. 4 mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* 10–12 mm long, 3–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* indistinct or to 3 mm long, to 4 mm diameter; *floral bracts* small, acute, 3–4 mm long, located below the calyx; *calyx* 17–18 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 5–6 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 9–10 mm long, 7–8 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); creamy yellow to white; *lower subcylindrical part of the corolla tube* c. 10 mm long, c. 5 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, c. 10 mm long, c. 16 mm wide at the top; *corolla lobes* 5, broad-obovate to

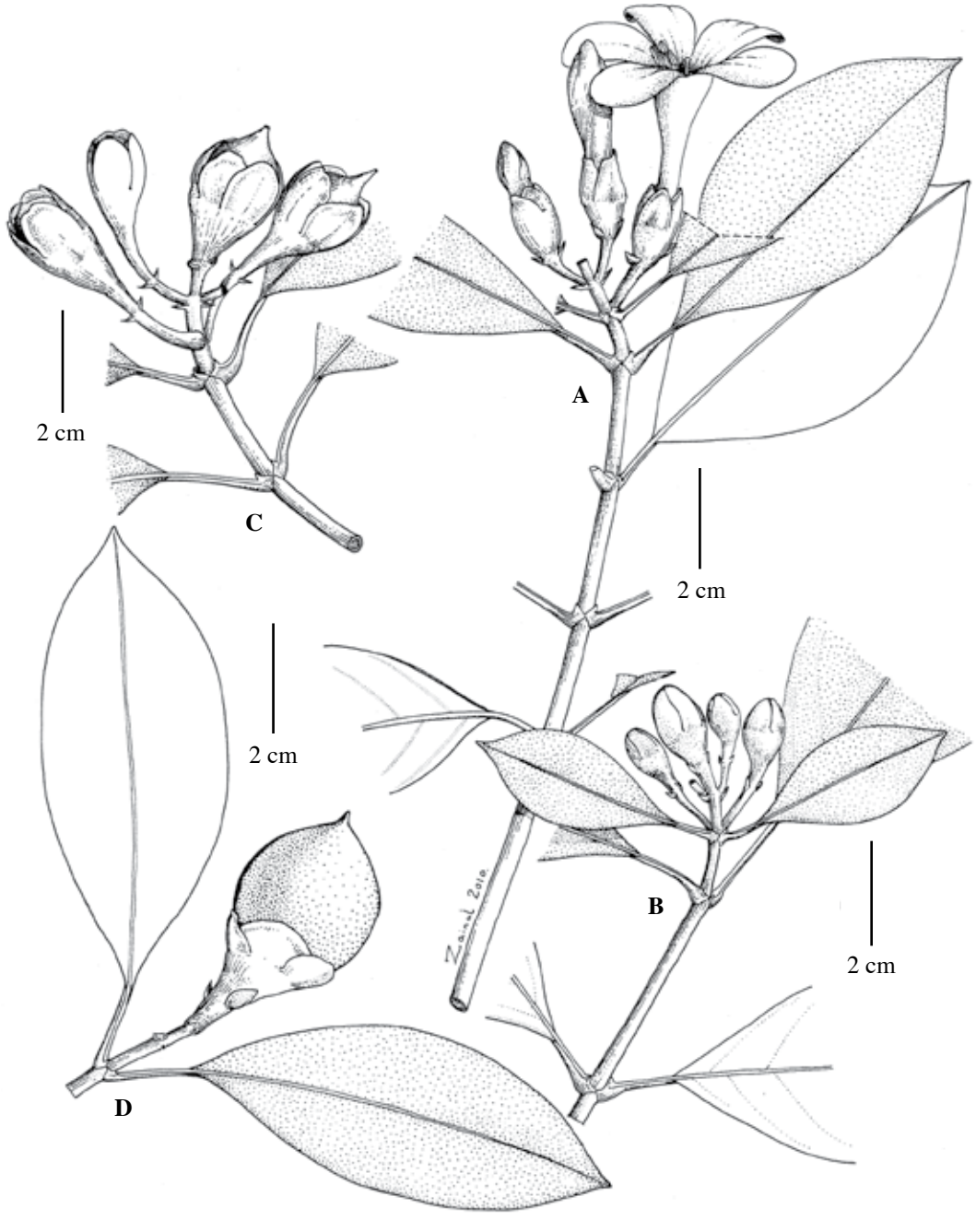

Fig. 16. *Fagraea larutensis*. **A**. Leafy branch with an inflorescence. **B**. Leafy branch with flower buds. **C**. Leafy branch with infructescence. **D**. Leafy branch with a single mature fruit. A from *King's Collector 7518* (holotype, SING), B from *Sidek SK 438* (SING), C from *Sinclair & Kiah SFN 38660* (SING), D from *Burkill & Haniff SFN 12585* (SING). (Drawing by Zainal Mustafa)

suborbicular, 15–16 mm long, 9–10 mm wide, overlapping to the right; *stamens* not seen; *style* not seen. **Infructescence** peduncle indistinct. **Fruit** broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 30–32 mm long, 20–30 mm diameter; the base loosely surrounded by the calyx lobes. **Seeds** numerous; ellipsoid–subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Known only from Peninsular Malaysia (at Maxwell Hill, also known as Bukit Larut).

HABITAT. Lower montane forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Perak. Gunung Hijau, 4400 ft [1341 m] alt, *Burkill & Haniff SFN 12585*, FR, 2 Mar 1924 (SING), Larut, 300 to 500 ft [91–152 m] alt, *King's Coll. 7518*, FB, FL, Apr 1885 (SING), Maxwell's Hill, between Birch's Hill and the Cottage, *Sinclair & Kiah SFN 38660*, FR, 10 Sep 1949 (SING), Maxwell's Hill, 3000–3700 ft [914–1128 m] alt, *Sidek SK 438*, FB, 15 Feb 1976 (SING); Taiping Hill, 4100 ft [1250 m] alt, *Henderson SFN 11807*, FR, 4 Mar 1924 (SING).

This species closely resembles *Fagraea crassifolia* Blume and *F. latibracteata* Sugumaran (described next). In *Fagraea crassifolia*, the calyx lobes (20–26 mm long) and corolla lobes (20–27 mm long) are larger and the corolla tube (16–17 mm long) is also shorter. *Fagraea larutensis* has small and acute floral bracts that are located below the calyx base and that are only 3–4 mm long, whereas *F. latibracteata* has larger and rounded floral bracts that overlap the calyx base and 17–18 mm long. Also, *Fagraea larutensis* is confined only to higher elevations in lower montane forests, whereas *F. crassifolia* and *F. latibracteata* are both lowland species.

ETYMOLOGY. Named after Larut, the type locality of this species.

12. *Fagraea latibracteata* M.Sugumaran, **sp. nov.**

Fagraeae larutensis similis sed floribus solitariis et bracteis floralibus rotundatis superpositis basi calycis differt.

TYPE: *Cockburn FRI 7252*, Kelantan, Ulu Kelantan, Relai Forest Reserve, ridge top, 18 Oct 1967 (holo KEP; iso SING).

Fagraea carnosa auct. non Jack (1822): Leenhouts, Fl. Males. I, 6 (2) (1962) 331 pro parte, quoad *Sinclair & Kiah SFN 39931*.

(Fig. 17)

Small tree or hemi-epiphyte, height not recorded; trunk/stem diameter not recorded; bark smooth, grey-brown. **Leaves** narrow elliptic; (5–)6.5–10(–13.2) cm long, (1.5–)2–4 cm

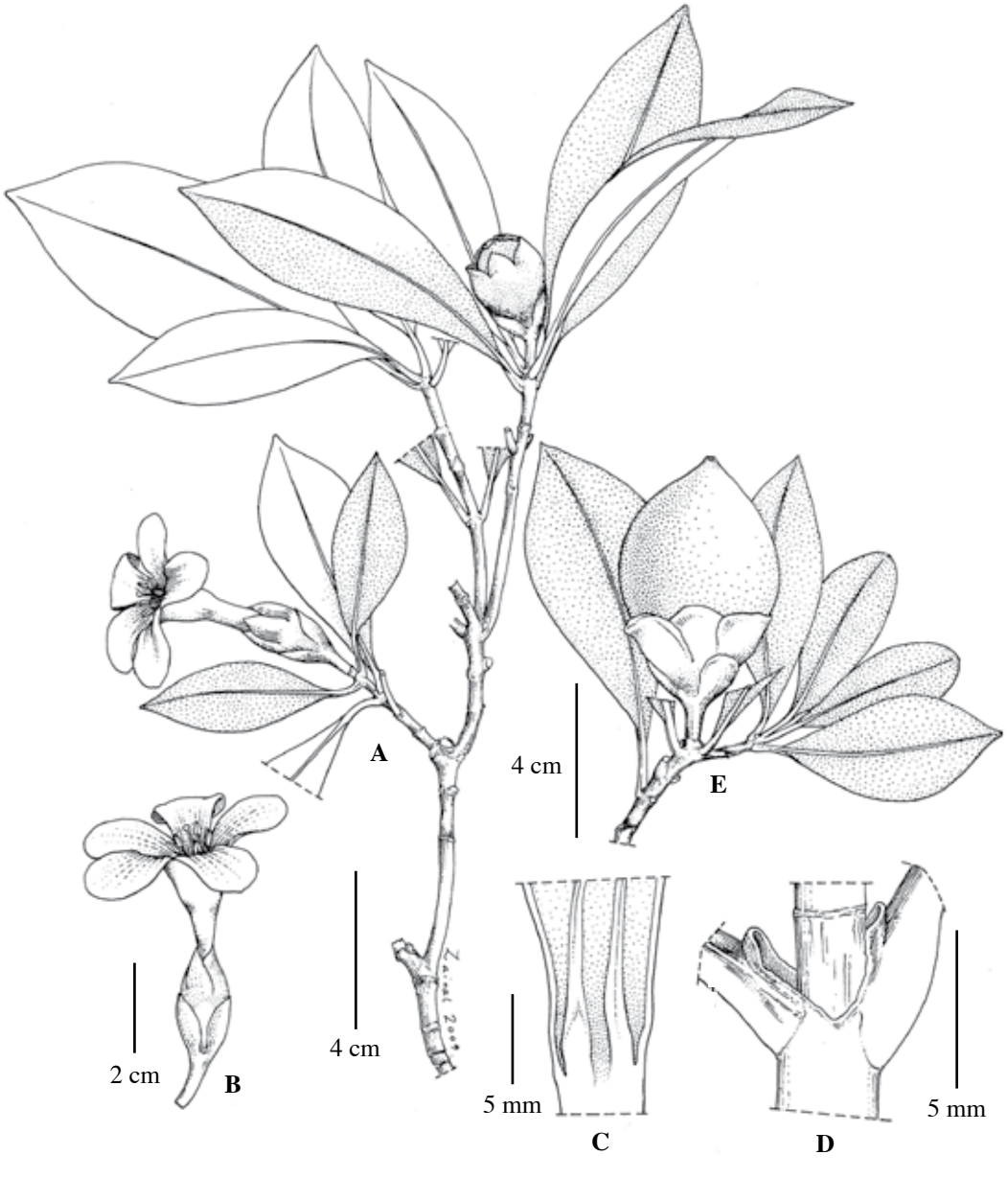

Fig. 17. *Fagraea latibracteata*. **A**. Leafy branch with a flower and a young fruit. **B**. Flower. **C**. Sectioned upper part of the corolla tube showing the attachment of the filament. **D**. Portion of stem node with ligules at the adaxial side of the petiole base. **E**. Leafy branch with fruit. A, D & E from *Cockburn FRI 7252* (holotype, KEP), B & C from *Sugumaran SM55* (KLU). (Drawing by Zainal Mustafa)

wide; *base* cuneate, not decurrent; *apex* short blunt cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat to sunken above, prominent below; *secondary veins* not visible on both sides; *tertiary and higher-order veins* obscure; petioles (8–)10–15 mm long, 1.5–2.5 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, of a solitary flower, the whole about 0.8–1.3 cm long; *peduncle* indistinct or to 6 mm long, to 4 mm diameter; the rachis internode between peduncle and pedicel indistinct or to 7 mm long, 5 mm diameter. **Flowers** bisexual; *pedicels* inconspicuous; *floral bracts* conspicuous, rounded, 17–18 mm long, overlapping the calyx base; *calyx* 20–22 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 8–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 10–12 mm long, 10–12 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 13–15 mm long, 5–7 mm wide basally, *upper flared part* of the tube slightly inflated, 10–15 mm long, 16–22 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 16–18 mm long, 13–15 mm wide, overlapping to the right; *stamens* 5, inserted (at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube); *filaments* 16–20 mm long, protruding 5–6 mm from the corolla mouth; *anthers* not seen; *style* not seen. **Infructescence** peduncle indistinct or to 3 mm long, to 3 mm thick. **Fruit** broadly ovoid to subglobose, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 32–55 mm long, 32–40 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. North-eastern part of Peninsular Malaysia, in the states of Kelantan, Pahang and Terengganu.

HABITAT. Lowland forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Endau-Rompin, Selai, trail to Takah Tinggi, *Sugumaran & Wong SM 55*, FL, 18 Oct 2005 (KLU). **Kelantan.** Ulu Kelantan, Relai Forest Reserve, *Cockburn FRI 7252*, FL, FR, 18 Oct 1967 (KEP). **Pahang.** Lipis, Taman Negara, K. Relau-K. Juram road, 440 m alt, *Saw FRI 44801*, FB, 8 Aug 1996 (KEP). **Terengganu.** 23rd mile Trengganu-Besut road, Belara F.R., *Sinclair & Kiah SFN 39931*, FB, 13 Jul 1953 (SING); Ulu Besut, near Bt. Jebak Puyoh, 200 ft [61 m] alt, *Cockburn FRI 8279*, FR, 2 May 1968 (KEP, SING).

Fagraea latibracteata closely resembles *F. larutensis* and *F. crassifolia*. The marked difference from these two species is that *Fagraea latibracteata* has larger floral bracts which are 17–18 mm long and overlap the calyx bases. *Fagraea larutensis* and *F. crassifolia* have small and acute floral bracts that are 6 mm long or less and located below the calyx base.

Another difference is that both *Fagraea larutensis* and *F. crassifolia* have branched 2- to few-flowered cymes, whereas *F. latibracteata* has solitary flowers.

ETYMOLOGY. In Latin, *lati-* and *bractea* mean broad bracts, referring to a key floral character of this species.

13. *Fagraea littoralis* Blume

Bijdr. (1826) 1021, Rumphia 2 (1838) 28, t. 74; Wong & Sugau, Sandakania 8 (1996) 73. TYPE: *Blume s.n.*, Java, Nusa Kambangan (holo L: acc no. 908127-530).

Fagraea forstenii Blume, Mus. Bot. 1 (1850) 166. TYPE: *Forsten s.n.*, Celebes (holotype L: acc. no. 908127-228)

Fagraea littoralis var. *amboinensis* Blume, Rumphia 2 (1838) 28, t. 74. TYPE: *Zippelius*, Moluccas, Ambon (L: acc. no. 908127-67).

Fagraea littoralis sensu Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 328 pro parte, excl. *F. crassifolia* Blume in syn.

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *F. littoralis* Blume & *F. forstenii* Blume in syn.

Fagraea obovata auct. non Wallich ex Roxburgh (1824): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 606 pro parte, quoad *Wray 2714 & 4269*; Ridley, Fl. Malay. Pen. 2 (1923) 418 pro parte, quoad 'Kamunting' (= *Wray 4269*).

(Fig. 18)

Hemi-epiphyte, height not recorded; trunk/stems diameter not recorded; bark smooth, grey-brown. **Leaves** elliptic to suborbicular; (5–)7–9(–10.5) cm long, (2.5–)3–5(–5.5) cm wide; *base* cuneate to rounded, not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface minutely wrinkled under magnification; *midrib* flat above, prominent below; *secondary veins* 7–10 pairs if visible, obscure on both sides; *tertiary and higher-order veins* obscure; petioles 10–15 mm long, 1–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 3 cm long; *peduncle* indistinct or to 8 mm long, to 3 mm diameter; inflorescence *rachis* c. 22 mm long, c. 2.5 mm diameter, with 1–3 pairs of primary branches; basal primary *branch pairs* c. 12 mm long, c. 2 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* 2–3 mm long, 2–3 mm diameter; *floral bracts* small, acute, 1.5–2 mm long, located below the calyx; *calyx* 8–10 mm long (from the base to the lobe apices), glabrous, to sometimes lenticellate, *calyx*

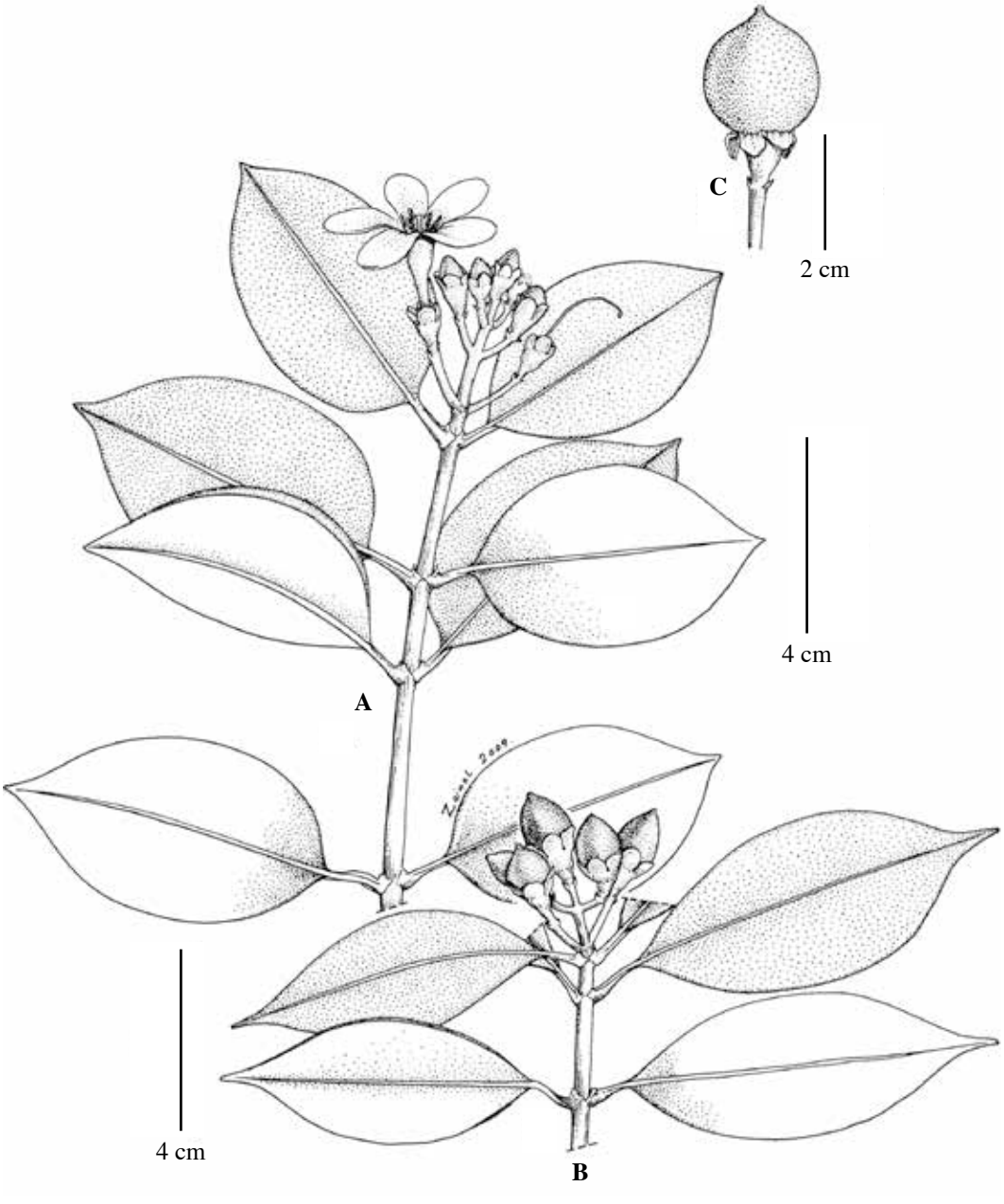

Fig. 18. *Fagraea littoralis*. **A**. Leafy branch with an inflorescence and open flower. **B**. Leafy branch with an infructescence. **C**. Fruit. A from *Wray 4268* (SING), B from *Wray 2714*, C from *Spare SFN 36006*. (Drawing by Zainal Mustafa)

cup 2.5–3 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 5–6 mm long, 5–7 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 10–16 mm long, 3–3.5 mm wide basally, *upper flared part* of the tube slightly inflated, 15–16 mm long, 12–14 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 15–22 mm long, 10–13 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 23–25 mm long, protruding to 12–13 mm from the corolla mouth; *anthers* versatile, hastate, 4–5 mm long, 1.5–2 mm wide, each anther sac somewhat ellipsoid; *style* 32–35 mm long, protruding to 3–7 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1.5–2 mm across. **Infructescence** peduncle indistinct or to 4 mm long, 3 mm thick. **Fruit** broadly ovoid to subglobose, *apex* slightly pointed to rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 18–20 mm long, 13–15 mm diameter; the base loosely surrounded by the calyx lobes (recurved and folding backwards in dried material). **Seeds** numerous; ellipsoid to subovoid; 1.5–2 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Java, Malay Peninsula, Sulawesi, Maluku.

HABITAT. Coastal sites not far from the sea.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. Sungai Kelantan, *Ridley 9157*, FL, Dec 1897 (SING). **Perak.** Larut, Kamunting, *Wray 4269*, FL, 1894 (SING); Matang, *Wray 2714*, FR, Aug 1888 (SING); Sungai Krian Estate, sea level, *Spare SFN 36006*, FR, 10 Jul 1938 (SING); Simpang, plains, *Wray 2248*, FR, no date (SING). **Selangor.** Batang Berjuntai, *Ridley 7551*, FB, FR, Mar 1891 (SING). **JAVA** (INDONESIA). Nusa Kambangan, *Blume s.n.*, FR, no date (L). **SULAWESI** (CELEBES) (INDONESIA). Tondano, *Forsten s.n.*, FR, no date (L).

The taxon in Peninsular Malaysia is the typical variety as represented by Javanese material; Wong & Sugau (1996) described *Fagraea littoralis* var. *borneensis* from Borneo, which has longer primary branches of the inflorescence (2–6 cm long) and longer calyx lobes (7–10 mm long).

14. *Fagraea oblonga* King & Gamble

J. As. Soc. Beng. 74 (2) (1908) 612; Ridley, Fl. Malay. Pen. 2 (1923) 417; Wong & Sugau, Sandakania 8 (1996) 78. LECTOTYPE (Wong & Sugau, Sandakania 8 (1996) 78): *King's Coll. 5430*, Perak, Larut (K).

(Fig. 19)

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *Burkill & Haniff SFN 12982*, *Henderson FMS Mus. 11128*, *Purseglove P 4141*, *Ridley 12069* & *s.n.*, March 1892, Perak Tea Gardens; Kochummen, Tree Fl. Malaya 2 (1973) 271 pro parte, quoad *F. oblonga* King & Gamble in syn.

Fig. 19. *Fagraea oblonga*. **A.** Habit of tree developing on rocky streambank. **B.** Leafy branch with infructescence. (Photos: M. Sugumaran)

Small tree or hemi-epiphyte, usually to 12 m tall or 10 m high or more on trees; trunk/stems to c. 15 cm diameter; bark smooth, grey to dark-brown. **Leaves** elliptic-lanceolate to subobovate; (11–)15–28(–36) cm long, 4–8(–10.7) cm wide; *base* cuneate to rounded, not decurrent; *apex* cuspidate; *margin* entire, recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* 7–10 pairs if visible, upper side faint and immersed in the lamina, lower side obscure; *tertiary and higher-order veins* obscure; petioles (20–)25–50(–60) mm long, 2–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1.5 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 1.2–3.6 cm long; *peduncle* indistinct or to 4 mm long, to 5 mm diameter; inflorescence *rachis* 1.2–2.7(–3.2) cm long, (1–)3–4 mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* 8–27 mm long, 1–3 mm diameter and not or rebranched to 1(–2) orders, more distal branch

pairs less so. **Flowers** fragrant; bisexual; *pedicels* 5–10 mm long, 1.5–3 mm diameter; *floral bracts* indistinct or present as a very small structure less than 0.5 mm long below the calyx; *calyx* 10–15 mm long (from the base to the lobe apices), glabrous, lenticellate, *calyx cup* 4–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 5–7 mm long, 5–6 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 10–20 mm long, 3–4 mm wide basally, *upper flared part* of the tube (when distinct) slightly inflated, 11–16 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 12–18 mm long, 8–10 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 18–22 mm long, protruding to c. 8 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 1.5–2 mm wide, each anther sac somewhat ellipsoid; *style* 22–30 mm long, protruding to 1–6 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–1.5 mm across. **Infructescence** peduncle indistinct or to 3 mm long, to 4 mm thick. **Fruit** broadly ovoid, *apex* rounded; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 32–46 mm long, 20–28 mm diameter; the base loosely surrounded to tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Malay Peninsula, Sumatra.

HABITAT. Lower montane forest, occasionally lowland forest on the foothills of mountains.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Kelantan. Gua Musang, Gunung Chamah, 947 m alt, *Hairul FRI 72264*, FR, 31 Jul 2010 (A, K, KEP, L, SAN, SAR, SING). **Negeri Sembilan.** Jelebu, Berembun F.R., Gunung Telapak Buruk, 1085 m alt, *Lim FRI 56592*, FR, 9 Apr 2008 (A, K, KEP, L, SAN, SING), *Imin FRI 63057*, FR, 11 Apr 2008 (K, KEP, L, SAN, SAR, SING). **Pahang.** Cameron Highlands, 3500 ft [1067 m] alt, *Henderson SFN 32967*, FL, 1 May 1937 (KEP), 4000 ft [1219 m] alt, *Quaife s.n.*, FR, Oct 1940 (SING), Boh Plantations, *Nur SFN 32967*, FB, 1 May 1937 (SING), Sungai Bertam, below Robinson's Falls, 3500 ft [1067 m] alt, *Henderson SFN 11128*, FB, FL, 18 Jun 1923 (SING); Fraser's Hill, waterfall, 3800 ft [1158 m] alt, *Manurung 27*, FR, 17 Jun 1972 (KLU), 4000–4370 ft [1219–1332 m] alt, *Burkill & Holttum SFN 7861*, FR, 16–30 Sep 1922 (KEP, SING), 4500 ft [1372 m] alt, *Mohd Shah MS 2730*, FR, 30 Aug 1972 (KEP, SING), Bukit Jeriau, *Kochummen FRI 19451*, FL, 11 May 1976 (KEP, SING), Farm Road, 3800 ft [1158 m] alt, *Purseglove P 4141*, FR, 17 Apr 1955 (SING), Gap, *Hashim KEP 1084*, FR, 3 Aug 1917 (KEP), *Sugumaran & Lee SM 176*, leafy branch only, 5 Mar 2008 (KLU), Jeriau (Farm) road, 3500-4000 ft [1067–1219 m] alt, *Burkill, Shah & Noor HMB 2421*, FR, 20 Aug 1960 (KEP, SING), Jeriau Road, *Stone, Mahmud & students BCS 10804*, FR, 17 Jun 1972 (KLU), Jeriau Waterfalls, *Sugumaran et al. SM 165*, FR, 3 Jan 2008 (KLU), SM 214,

FR, 22 May 2008 (KLU), Ulu Jeriau, 3500 ft [1067 m] alt, *Loh FRI 19156*, FR, 27 Aug 1971 (KEP, SING); Genting Highlands, around Awana Area, *Sugumaran & Lee SM 175*, leafy branch only, 4 Mar 2008 (KLU); Telom, *Ridley 13838*, FR, Nov 1908 (SING); Ulu Sungai Boh, 3000 ft [914 m] alt, *Whitmore FRI 20117*, FR, 3 Jun 1971 (KEP). **Perak.** *Scortechini s.n.*, FR, 21 Jun 1909 (K, SING); Cottage, *Ridley 5558*, FR, Jun 1893 (SING); Maxwell's Hill, *Wray s.n.*, FB, FL, no precise date, 1889 (SING), *Wray 2992*, FR, Sep 1888 (SING); Birch's Hill, 3800 ft [1158 m] alt, *Burkill & Haniff SFN 12982*, FL, FR, 3 Mar 1924 (SING); Larut, 2500–3000 ft [762–914 m] alt, *King's Coll. 5430*, FR, no precise date, Jan 1884 (K); Larut Hill, 1100 m alt, *Damahuri FRI 36505*, FR, 18 Oct 1988 (KEP); Maxwell's Hill, 3100 ft [945 m] alt, *Burkill & Haniff SFN 12685*, FR, 6 Mar 1924 (SING), *Sugumaran SM 4*, leafy branch only, 12 Sep 2003 (KLU); Taiping Hill, 3100 ft [945 m] alt, *Henderson SFN 11838*, FR, 6 Mar 1924 (SING); Tea Gardens, *Ridley s.n.*, FR, Mar 1892 (SING). **Selangor.** Selangor border, Semangkok Pass, *Ridley 12069*, FR, Aug 1904 (SING); near Ginting Highlands College site, 3000 ft [914 m] alt, *Kochummen FRI 16514*, FL, FR, 9 May 1972 (KEP, SING); Selangor/Pahang, Gunung Ulu Kali, 5200 ft [1585 m] alt, *Mahmud s.n.*, FR, Apr 1970 (KLU).

Leenhouts (1962) acknowledged that *Fagraea oblonga* is "a very characteristic form" (of his heterogeneous *F. ceilanica*). The generally elongate, clearly petiolate leaves with parchment-like lower surfaces when dried afford ready recognition of this species.

15. *Fagraea renae* K.M.Wong & Sugau

Sandakania 8 (1996) 82, excl. *Rena S 40346* (= *F. ridleyi* King & Gamble). TYPE**:** *Anderson S 19121*, Sarawak, Bau, Bidi (holo SAN; iso K, L, SAR, SING). x

Fagraea vaginata King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 610 pro parte, excl. speciminia origine Javae (= *F. blumei* G. Don).

Fagraea blumei auct. non G. Don (1837): Leenhouts, Fl. Males. I, 6 (2) (1962) 320 pro parte, excl. *F. plumeriaeflora* DC. & *F. vaginata* King & Gamble in syn., excl. speciminia origine 'Java' & 'Celebes'.

(Fig. 20)

Small tree or hemi-epiphyte, usually to 10–13 m tall or 10–12 m high on trees; trunk/stems to c. 15 cm diameter; bark smooth, grey-brown; branch internodes terete, smooth. **Leaves** elliptic to subobovate; (10–)15–21(–23.5) cm long, (4.5–)6–10(–11.5) cm wide; *base* cuneate, not decurrent; *apex* short cuspidate; *margin* entire, plane recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* flat above, prominent below; *secondary veins* (4–)5–7 pairs, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* obscure; petioles (2–)2.5–3.5(–4) cm long, 2–3(–4) mm thick, *petiolar sheaths* not fused

Fig. 20. *Fagraea renae*, habit. (Photo: M. Sugumaran)

along the interpetiolar median, each developing a scale-like ligule 1–2 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 3.5–5.5(–6.2) cm long; *peduncle* indistinct; inflorescence *rachis* 3.5–5.5(–6.2) cm long, 2.5–3(–4) mm diameter, with 2–3 pairs of primary branches; basal primary *branch pairs* (1–)2.8–5(–6) cm long, 2–4(–5) mm diameter and rebranched to 1–2(–3) orders, more distal branch pairs less so. **Flowers** fragrant; bisexual; *pedicels* 5–10 mm long, 3–4 mm diameter; *floral bracts* small, acute, 2–4 mm long, located below the calyx; *calyx* (from the base to the lobe apices) 15–22 mm long, glabrous, lenticellate, *calyx cup* 5–6 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 5–10 mm long, (6–)14–16 mm wide, margins glabrous, base not auriculate; *corolla* slender trumpet-shaped (tubular and very gradually widening towards the apex); cream to white; *lower subcylindrical part of the corolla tube* 18–22 mm long, 4–6 mm wide basally, *upper flared part* of the tube slightly inflated, (5–)10–12 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 19–27 mm long, 10–15 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 20–26 mm long, protruding

to 10–14 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 2–2.5 mm wide, each anther sac somewhat ellipsoid; *style* 28–32 mm long, not to slightly protruding to c. 5 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive sometimes resembling a subpeltate structure 1.5–2 mm across. **Infructescence** peduncle indistinct. **Fruit** broadly ovoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 35–40(–47) mm long, 2–2.5 mm diameter; the base tightly to loosely surrounded by the erect calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo (Sabah, Sarawak), Malay Peninsula.

HABITAT. Lowland to lower montane forests, often by streams; also in secondary forests and on limestone outcrops.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Gunung Panti West, 1000 ft [305 m] alt, *Whitmore FRI 15697*, FB, 13 Dec 1970 (KEP); Pahang border, Labis Forest Reserve, 500 ft [152 m] alt, *Samsuri & Ahmad SA 516*, FR, 19 Feb 1971 (KEP). **Kedah.** Gunung Inas F.R., compt. 8, 3000 ft [914 m] alt, *Whitmore FRI 4661*, FR, 7 Feb 1968 (KEP). **Pahang.** Ulu Kuantan, 400 ft [122 m] alt, *Symington & Kiah SFN 28923*, FB, FL, 17 Jun 1934 (SING). **Perak.** *Wray 1992*, FL, FR, 1885 (SING); Huks Kenas, *Scortechini 817*, FB, May 1884 (SING); Larut, 300 ft [91 m] alt, *King's Coll. 4238*, FL, May 1883 (SING), 500–600 ft [152–183 m] alt, *King's Coll. 3868*, FL, FR, Feb 1883 (L, SING); Slim Hills F.R., banks of Sungai Geliting, 2000 ft [610 m] alt, *Whitmore FRI 730*, FR, 5 Sep 1966 (KEP, SING); Tapah Hills, Sungai Woh, *Ng FRI 1373*, FB, 14 Jul 1966 (K, KEP, L); Ulu Bubong, *King's Coll. 10124*, FB, FL, Jun 1886 (SING). **Selangor.** Bukit Takun, northeast side, 500 ft [152 m] alt, *Chin 569*, leafy twig only, 31 Dec 1970 (KLU); Genting Sempah ridge, 800 m alt, *Stone 15168*, FR, 21 May 1982 (KLU); Gunung Ulu Kali, 5200 ft [1585 m] alt, *Mahmud s.n.*, FR, May 1972 (KLU); Rawang, *Ridley 7607*, FL, FR, May 1896 (SING); Sungai Tua, *Sugumaran et al. SM 26*, FR, 20 Jan 2005 (KLU, SING), recreation site, *Sugumaran et al. SM 177*, FR, 6 Mar 2008 (KLU); Templer Park, Bukit Anak Takun, *Sang JS 67*, FB, FR, 6 Dec 1995 (KEP); Templer Park Country Club Golf Course, stone outcrop 100 m from Bukit Takun, *Sugumaran & Vijayandra SM 98*, FR, 8 Jul 2007 (KLU); Ulu Langat, *Gadoh KL 1592*, FR, 8 Jul 1959 (KEP, SING); Ulu Gombak, 2000 ft [610 m] alt, *Saw FRI 34065*, FB, FR, Apr 1985 (KEP). **Terengganu.** Ulu Brang, Gunung Padang, Camp 1 near K. Lallang, 300 ft [91 m] alt, *Whitmore FRI 12610*, FB, 16 Sep 1969 (KEP, SING).

A number of specimens of *Fagraea renae* from Peninsular Malaysia have been earlier misidentified by Kochummen in the Kepong herbarium (KEP) as *F. ridleyi*, although this is not evident through the descriptions in his brief key (Kochummen 1973). These include: *Gadoh KL 1592*, *Whitmore FRI 4661*, *12610* and *15697*.

Bornean material of *Fagraea renae* available after the account of Leenhouts (1962) were also misidentified as *F. ridleyi*. These include *Aban SAN 81130*, *Aban & Leopold SAN 80987*, *Cockburn SAN 84984 & 85112*, *Dadau SAN 44903*, *Free & Sumbing SAN 79152* and *Muin Chai SAN 25981* (all at L and SAN).

16. *Fagraea ridleyi* King & Gamble

J. As. Soc. Beng. 74 (2) (1908) 612; Ridley, Fl. Malay. Pen. 2 (1923) 417; Leenhouts, Fl. Males. I, 6 (2) (1962) 320; Kochummen, Tree Fl. Malaya 2 (1973) 271; Wong & Sugau, Sandakania 8 (1996) 87. LECTOTYPE (Leenhouts, Fl. Males. I, 6 (2) (1962) 320): *Ridley 5845*, Singapore (SING; isolecto K).

Fagraea renae K.M.Wong & Sugau, Sandakania 8 (1996) 82 pro parte, quoad *Rena S 40346*.

(Fig. 21)

Small tree or hemi-epiphyte, usually to 6 m tall or up to 30 m high or more on trees; trunk/stems to c. 13 cm diameter; bark smooth to lenticellate, dark-brown; branch internodes terete, smooth. **Leaves** broad elliptic to subobovate; (13–)17–22(–25.5) cm long, (7.5–)9–12(–16) cm wide; *base* cuneate, not decurrent; *apex* rounded; *margin* entire, plane in dried material; thick-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth; *midrib* prominent above towards the leaf base but flat to sunken nearer the leaf apex, prominent below; *secondary veins* (3–)4–5, upper side faint and immersed in the lamina, lower side prominent; *tertiary and higher-order veins* obscure; petioles (1.5–)2–3(–4.3) cm long, 3–5(–6) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 1–3 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2- to few-flowered branched cyme, the whole about 5–6 cm long; *peduncle* distinct, 2.5–3.5 cm long, 7–9 mm diameter; inflorescence *rachis* 25–30 mm long, 5–8 mm diameter, with 1–2 pairs of primary branches; basal primary *branch pairs* 20–30 mm long, 3–4 mm diameter and rebranched to 1(–2) orders, more distal branch pairs less so. **Flowers** bisexual; *pedicels* 15–17 mm long, 3–5 mm diameter; *floral bracts* small, acute, 3–4 mm long, located below the calyx; *calyx* 33–35 mm long (from the base to the lobe apices, glabrous, lenticellate, *calyx cup* 8–10 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 13–15 mm long, 13–15 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream to white; *lower subcylindrical part of the corolla tube* 18–20 mm long, 3–6 mm wide basally, *upper flared part* of the tube slightly inflated, 14–17 mm long, 14–18 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 17–20 mm long, 10–15 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 25–28 mm long, protruding to c. 10 mm from the corolla mouth; *anthers* versatile, hastate, 8–10 mm long, 2–4 mm wide, each anther sac somewhat ellipsoid; *style* 40–45 mm long, protruding to c. 8 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the

Fig. 21. *Fagraea ridleyi*. **A.** Fruiting leafy branches, with (inset) fruit cluster. **B.** Resinous shoot tip and leaves with glands (extrafloral nectaries). **C.** Node with petiolar sheath. (Photo credits: K.M. Wong except inset in A, M. Sugumaran)

lobes broadly suborbicular and recurving when receptive, the whole sometimes resembling a subpeltate structure c. 2 mm across. **Infructescence** *peduncle* distinct, 15–20(–35) mm long, 4–6 mm thick. **Fruit** broadly ovoid to subglobose, *apex* conspicuously attenuated; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 40–50(–55) mm long, 20–32(–42) mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Malay Peninsula, Lingga.

HABITAT. Lowland rain forest (including some *kerangas* forest sites in Borneo).

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Mt. Ophir, 800 ft [244 m] alt, *Wong FRI 32191*, FR, 19 Mar 1981 (KEP); Ulu Endau, 1200 ft [366 m] alt, *Cockburn FRI 8026*, FR, 31 Mar 1968 (KEP, SING). **Melaka.** Mt. Ophir, *Ridley 3785*, FR, no precise date, 1892 (SING). **Pahang.** Bukit Ibam, Muazam Shah, *Low LYW 227*, FR, 27 Nov 2008 (KLU, SING); Jalan Sepadan, *Machado* s.n., FR, 13 May 1903 (SING). **LINGGA** (INDONESIA). Sungai Bei, *Hullett s.n.*, FB, FR, 23 Jul 1893 (SING). **SINGAPORE.** Botanic Gardens, *Henderson SFN 1381*, FR, Dec 1921 (SING), cultivated near Bandstand, probably from Bukit Timah, *Ridley s.n.*, FR, Aug 1899 (SING: barcode SING0011372), Lawn H, *Nur SFN 18191*, FR, 28 Feb 1928 (KEP); Bukit Timah, *Ridley* (no. indistinct), leaves only, 12 Aug 1889 (SING), *Ridley 2767*, FR, no precise date, 1891 (SING), *Ridley 5845*, FR, no precise date, 1894 (K, SING), *Ridley 11363*, FL, no precise date, 1902 (SING); between Sungai Karang and Sungai Morai, *Sinclair SFN 40176*, leafy branch only, 19 Dec 1953 (SING).

The non-auriculate, distinctly petiolate leaves with a very coarsely thick-coriaceous texture and prominent secondary veins on the lower surface when dried, and robust inflorescence axes and flower calyces, readily distinguish this species (see Key).

17. *Fagraea splendens* Blume

Mus. Bot. 1 (1850) 168; Wong & Sugau, Sandakania 8 (1996) 87. TYPE: *Korthals s.n.*, Borneo (holo L: acc. no. 908127-639 & barcode L0004984).

Fagraea acuminatissima Merr., J. Str. Br. R. As. Soc. 77 (1917) 232; Leenhouts, Fl. Males. I, 6 (2) (1962) 319; Kochummen, Tree Fl. Malaya 2 (1973) 271. TYPE: *Native coll. 686*, Sarawak (iso K, L).

Fagraea heterophylla Blume, Mus. Bot. 1 (1850) 168. TYPE: *Korthals*, *s.n.*, Borneo, Banjermarsing (holo L: acc. no. 908127-518 & barcode L0004986).

Fagraea longicuspis Gand., Bull. Soc. Bot. Fr. 65 (1918) 58. TYPE: *Curtis 3013*, Pulau Penang, May 1893 (iso SING).

Fagraea ceilanica auct. non Thunberg (1782): Leenhouts, Fl. Males. I, 6 (2) (1962) 315 pro parte, quoad *F. heterophylla* Blume & *F. splendens* Blume in syn.

Fagraea obovata auct. non Wallich ex Roxburgh (1824): King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 606 pro parte, quoad *Curtis 246*, *King's coll. 4878*, *Wray 2115*, *3075*, *4181*; Ridley, Fl. Malay. Pen. 2 (1923) 418 pro parte, quoad specim. *Curtis* (Kwala Lumpur), *Burn-Murdoch* (Gombak), *King's coll.* (Ulu Bubong), *Wray* (Batu Togoh); Craib & Kerr, Fl. Siam. Enum. 3 (1) (1951) 56.

(Fig. 1A & B, 2D, 3D, 5C, 22)

Small shrub or hemi-epiphyte, usually to 3 m tall or 10 m high or more on trees; trunk/stems to c. 10 cm diameter; bark smooth, grey to dark-brown. **Leaves** elliptic to obovate; (5.5–)10–20(–23) cm long, (2.8–)4–8(–9.3) cm wide; *base* cuneate to rounded, not decurrent; *apex* short cuspidate; *margin* entire, recurved in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface relatively smooth under magnification; *midrib* flat to sunken above, prominent below; *secondary veins* 5–7 pairs if visible, otherwise obscure on both sides; *tertiary and higher-order veins* obscure; petioles (5–)20–35(–47) mm long, (1.5–)2–3(–4) mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a few- to many-flowered branched cyme, the whole about 5–10 mm long; *peduncle* indistinct or to 5 mm long, to 5 mm diameter; inflorescence *rachis* 4–8 mm long, 2–4 mm diameter, with (1–)2 pairs of primary branches; basal primary *branch pairs* 3–4 mm long, 2–3 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* 2–4 mm long, 2.5–4 mm diameter; *floral bracts* small, acute, 2–3 mm long, located below the calyx; *calyx* 6–10 mm long (from the base to the lobe apices), glabrous, not to sometimes lenticellate, *calyx cup* 3–5 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 4–6 mm long, 4–6 mm wide, margins glabrous, base not auriculate; *corolla* broadly infundibular (the mouth more than 3–4 times the width of the lower narrowed part of the tube); cream

Fig. 22. *Fagraea splendens*, infructescences terminating leafy shoots. (Photo: K.M. Wong)

to white; *lower subcylindrical part of the corolla tube* 12–18(–20) mm long, 2–4 mm wide basally, *upper flared part* of the tube slightly inflated, 13–17 mm long, 10–15 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 13–20(–23) mm long, 6–12 mm wide, overlapping to the right; *stamens* 5, inserted (at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube); *filaments* 20–25 mm long, protruding to 7–8 mm from the corolla mouth; *anthers* versatile, hastate, 5–6 mm long, 2–2.5 mm wide, each anther sac somewhat ellipsoid; *style* 40–45 mm long, protruding to 8–15 mm from the corolla mouth in the open flower; *stigma* basically shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–2 mm across. **Infructescence** peduncle indistinct or to 5 mm long, to 4 mm thick. **Fruit** narrowly ellipsoid, *apex* conspicuously attenuate; smooth, the epidermis conspicuously wrinkling and separating upon drying; when mature to 20–30 mm long, 12–16 mm diameter; the base tightly clasped by the calyx lobes. **Seeds** numerous; ellipsoid to subovoid; 2–2.5 mm long, 1–1.5 mm wide; testa surface areolate.

DISTRIBUTION. Borneo, Malay Peninsula, Sumatra.

HABITAT. Sea level to lower montane forest; also in peat swamp and freshwater swamp forests.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Johor. Kota Tinggi-Mersing road, *Sinclair SFN 10608*, FB, 23 Jun 1961 (SING); Gunung Panti Forest Reserve, 1700 ft [518 m] alt, *Samsuri SA 315*, FL, 5 Jul 1970 (SING); Gunung Panti, Recreational forest, *Sugumaran SM 208*, leafy twig only, 29 Apr 2008 (KLU); Gunung Panti West, 1684 ft [513 m] alt, *Stone 14616*, FR, 25 Nov 1980 (KLU), below 1500 ft [457 m] alt, *Heaslett 7*, FL, 25 Jun 1967 (SING); Mawai-Jemaluang road, *Corner s.n.*, FR, 15 May 1935 (SING); Pontian, Pengkalan Raja, peat forest, *Henderson SFN 36671*, FR, 30 Jun 1939 (KEP); Tanjung Bunga, *Ridley 6312*, FL, 1894 (SING). **Kedah.** Langkawi, Gunung Raya Virgin Jungle Reserve, *Zahid et al. ZMS 42*, FL, 27 Apr 2004 (KLU), road to Ayer Hangat, Kisap F.R., *Allen KEP 79285*, FL, 13 May 1957 (KEP), Telaga Tujuh, c. 125 m alt, *Stone 15938*, FB, FL, 26 Apr 1987 (KEP); Polo Songsong, *Curtis s.n.*, FB, FL, Jun 1890 (SING), *Ridley s.n.*, FB, Jun 1890 (SING); Sik, Bukit Enggang, *Shah & Tan MS 5051*, FR, 5 May 1993 (SING). **Kelantan.** Jeli F.R., Compt. 20, *Chelliah FRI 6513*, FR, 30 Jun 1968 (KEP, SING). **Melaka.** no locality, *Alvins 179*, FR, 10 Dec 1884 (SING); stream below Gunung Mering, *Ridley 3182*, FL, Jun 1892 (SING). **Pahang.** Fraser's Hill, *Keng, Wee & Honours students T3/48*, FR, 11 Nov 1981 (SING); Gunung Tapis, 1500 ft [457 m] alt, *Chan FRI 19905*, FR, 29 Sep 1971 (KEP, SING); Jerantut, confluence of Sungai Tekam and Sungai Balol, *Ng & Beltran FRI 6389*, FR, 25 Jun 1972 (KEP); Rompin, Pulau Lang, *Mohamad KEP 14972*, FB, FL, 13 Jun 1929 (KEP); Sungai Bebar, *Sugumaran SM 38*, leafy twig only, 11 Apr 2005 (KLU). **Penang.** *Curtis 346*, FB, FL, Jul 1885 (SING); Batu Feringy, *Curtis 3013*, FR, May 1894 (SING); Penang Hill near Craig Hotel, *Henderson SFN 21412*, FL, 19 Jun 1937 (SING); Penang

Hill near Richmond Hotel, *Sugumaran & Vijayandra SM 167*, leafy twig only, 16 Feb 2008 (KLU); Waterfall stone quarry, *Haniff SFN 3755*, FL, 18 Jun 1918 (SING). **Perak.** Assam Kumbang, *Wray 3075*, FB, FL, FR, Sep 1888 (SING), *Wray 2115*, FB, FL, Jun 1888 (SING); Chenderiang, Gunung Bujang Melaka, Sungai Rias, 2000 ft [610 m] alt, *Shah & Ahmad MS 3408*, FR, 12 Feb 1975 (KEP, SING); Larut, 300 to 800 ft [91–244 m] alt, *King's Coll. 4878*, FR, Aug 1883 (SING), *King's Coll. 6162*, FL, May 1884 (SING); Larut, 500–700 ft [152–213 m] alt, *King's Coll. 10634*, FR, Jul 1886 (SING); Larut, Batu Togoh, *Wray 4181*, FB, Jun 1892 (SING). **Selangor.** Gombak, *Burn-Murdoch 117*, FL, no date (SING); Kwala Lumpur, *Curtis 2356*, FR, Feb 1890 (SING); Ulu Langat, *Gadoh KL 2167*, FR, 1 Aug 1960 (KEP), *Gadoh KL 2215*, FL, 16 Nov 1960 (KEP). **PENINSULAR THAILAND.** Pattani. Kao Kalakiri, *Kerr 7778*, FL, 10 Sep 1923 (BK). Phuket. Krabi, Tambon Kao Panom, *Kerr 18837A*, FR, 4 Apr 1930 (BK); Ranawng, Kao Pawta Chongdong, *Kerr 16775*, FL, 20 Jan 1929 (BK); Satul, *Kerr 13674*, FR, 27 Dec 1927 (BK). **SINGAPORE.** Mandai road, swampy forest, *Kiah & Henderson SFN 37739*, FR, 12 Aug 1940 (KEP). **BORNEO** (INDONESIA). *Korthals s.n.*, FB, no date (L: acc. no. 908127-639 & barcode L0004984); Banjermasing, *Korthals s.n.*, FR, no date (L: acc. no. 908127-518 & barcode L0004986).

This is a very common species in the Malay Peninsula. The flowers in subsessile, tight clusters, small infundibular corollas and obscure leaf veins distinguish the species quite well.

18. *Fagraea tubulosa* Blume

Mus. Bot. 1 (1850) 167; Miquel, Fl. Ind. Bat. 2 (1857) 373; King & Gamble, J. As. Soc. Beng. 74 (2) (1908) 604; Cammerloher, Bull. Jard. Bot. Btzg. III, 5 (1923) 326; Ridley, Fl. Malay. Pen. 2 (1923) 415; Leenhouts, Fl. Males. I, 6 (2) (1962) 320; Kochummen, Tree Fl. Malaya 2 (1973) 270. TYPE**:** *Blume*, *s.n.*, in sylvis montanis insulae Sumatrae (holo L: acc. no. 908127-615 & barcode L0005079; iso L: acc. no. 908127-626 & barcode L0005080).

Scrambler to hemi-epiphyte, usually to 5 m high or more on trees; bark smooth, grey-brown; branch internodes terete, smooth. **Leaves** ovate; (10–)13–19.5 cm long, 5.5–8 cm wide; *base* rounded not decurrent; *apex* short cuspidate; *margin* entire, plane in dried material; thin-coriaceous; upper and lower *surfaces* glabrous, lower surface minutely wrinkled under magnification; *midrib* flat above, prominent below; *secondary veins* 5–7 pairs if visible, obscure on both sides; *tertiary and higher-order veins* obscure; petioles 20–32 mm long, 2–3 mm thick, *petiolar sheaths* not fused along the interpetiolar median, each developing a scale-like ligule 0.5–1 mm high adaxially; petiole base without *auricles*. **Inflorescence** terminal, a 2–3-flowered cyme; *peduncle* indistinct or to 3 mm long, to 4 mm diameter; inflorescence *rachis* very condensed, with 1 pair of primary branches; basal primary *branch pairs* 1–2 mm long, 3–4 mm diameter and not rebranched. **Flowers** bisexual; *pedicels* 4–5 mm long, 3–4 mm diameter; *floral bracts* small, acute, 1–2 mm long, located below the calyx; *calyx* 5–7 mm long (from the base to the lobe apices), glabrous, not lenticellate, *calyx*

cup 3–4 mm diameter, *calyx lobes* 5, broad-elliptic to rounded, 4–5 mm long, 4–5 mm wide, margins glabrous, base not auriculate; *corolla* subsalverform (with a long narrow lower tube and patent to erect lobes); cream to white; *lower subcylindrical part of the corolla tube* 70–85 mm long, 2–4 mm wide basally, *upper flared part* of the tube slightly inflated, 5–8 mm long, 5–6 mm wide at the top; *corolla lobes* 5, broad-obovate to suborbicular, 10–13 mm long, 5–7 mm wide, overlapping to the right; *stamens* 5, inserted at the upper portion of the lower narrowed tubular part of the corolla tube or the lowermost portion of the upper flared part of the corolla tube; *filaments* 15–18 mm long, protruding to c. 10 mm from the corolla mouth; *anthers* versatile, hastate, 3–4 mm long, 1.5–2 mm wide, each anther sac somewhat ellipsoid; *style* 85–88 mm long, protruding 5–10 mm from the corolla mouth in the open flower; *stigma* shallowly 2-lobed, the lobes broadly suborbicular and recurving when receptive and the whole sometimes resembling a subpeltate structure 1–2 mm across. **Infructescence** not seen. **Fruit** not seen.

DISTRIBUTION. Sumatra, Malay Peninsula (collected only once, in Perak).

HABITAT. Lowland rain forest.

SPECIMENS EXAMINED—PENINSULAR MALAYSIA. Perak. Bujang Malacca, *Ridley 9738*, FL, no precise date, 1898 (SING). **SUMATRA** (INDONESIA). *Blume s.n.*, FB, FL, no precise date (L: acc. no. 908127-615 & barcode L0005079), FB, FL (L: acc. no. 908127-626 & barcode L0005080).

The slender, non-infundibular corolla shape is shared with *Fagraea gardenioides* and *F. carnosa*. Both these other species have thicker corolla tubes with longer lobes (more than 20 mm long) and also differ by their elliptic to obovate, thick-coriaceous leaves with recurved margins when dry (in *F. tubulosa*, the leaves are ovate, thin-coriaceous and do not have recurved margins).

ACKNOWLEDGEMENTS

The authors are grateful to the Institute of Biological Sciences, University of Malaya for research facilities and would like to thank the National Parks Board Singapore and Singapore Botanic Gardens for support leading to the completion of these studies. We are also grateful to curators and keepers of the various herbaria who have sent specimens on loan or allowed us to consult their material. Dr David Middleton (SING) advised on a number of nomenclatural matters. The late Professor Christian Puff (University of Vienna), our close collaborator over many years, composed the Latin diagnoses for *Fagraea larutensis* and *F. latibracteata*, and Dr Michele Rodda (SING) helped correct those for the other three novelties here. The line-drawings are the work of Zainal Mustafa (Rimba Ilmu, University of Malaya). We thank Ang Wee Foong (NParks Singapore) for allowing the use of his photo-images. Louise Neo helped in the composition of some figures.

REFERENCES

Blume, C.L. (1826) *Bijdragen tot de Flora van Nederlandsch Indië*. Lands Drukkerij, Batavia. Pp. 1020–1022.

Blume, C.L. (1836–49) *Rumphia* 4 vols. Leiden. (*Fagraea*: Tab. 72–81 pub. 1838.)

Blume, C.L. (1850) *Stirpium exoticarium novarum vel minus cognitarium ex vivis aut siccis brevis exposito et descriptio*. Lugduni-Batavorum. Pp. 163–173.

Burck, W. (1892) Wandelingen door den Botanischen Tuin. In: M. Treub (ed), *'s Lands Plantentuin te Buitenzorg, 18 Mei 1817–18Mei 1892*. Lands Drukkerij, Batavia.

Cammerloher, H. (1923) Die Loganiaceen und Buddleiaceen Niederländisch-Indiens. *Bull. Jard. Bot. Buitenzorg*. Series III, 5 (4): 295–338.

Corner, E.J.H. (1988) *Wayside Trees of Malaya*. 3rd ed. Vol. 1. Malayan Nature Society, Kuala Lumpur. Pp. 466–470.

Craib, W.G. & A.F.G. Kerr (1951) *Florae Siamensis Enumeratio. A list of the plants known from Siam*. Vol. 3, No. 1. Siam Society, Bangkok. Pp. 54–57.

Don, G. (1831–1838) *A General History of the Dichlamydeous Plants*. 4 vols. London.

Elias, T.S. (1983) Extrafloral nectaries: their structure and distribution. In: B. Bentley & T. Elias (eds.), *The Biology of Nectaries*. Columbia University Press, New York. 259 p.

Griffin, O. & J. Parnell (1997) Loganiaceae. In: T. Santisuk & K. Larsen (eds.), *Flora of Thailand* 6 (3): 197–205 (*Fagraea*).

Hallé, F, R.A.A. Oldeman & P.B. Tomlinson (1978) *Tropical Trees and Forests. An Architectural Analysis*. Springer-Verlag, Berlin. 411 p.

Henderson, M.R. (1933) *Additions to the Flora of the Malay Peninsula. Gard. Bull. Straits Settlem*. 7 (2): 113–115.

Hooker, J.D. (1885) *The Flora of British India*. Vol. 4. L. Reeve & Co., London. Pp. 82–85.

Jack, W. (1822) *Descriptions of Malayan Plants. Malayan Miscellanies*. Vol. 2 No. 7. Sumatran Mission Press, Bencoolen. Pp. i–iii, 81–82.

King, G. & J.S. Gamble (1904) *Materials for a Flora of the Malayan Peninsula*. Baptist Mission Press, Calcutta. Pp. 813–822.

King, G. & J.S. Gamble (1908) Flora of the Malayan Peninsula. *J. Asiat. Soc. Bengal* 74 (2): 603–612.

Kochummen, K.M. (1973) Loganiaceae. In: T.C. Whitmore (ed.), *Tree Flora of Malaya*. Vol. 2. Longman Malaysia, Kuala Lumpur. Pp. 296–275.

Leenhouts, P.W. (1962) Loganiaceae. In: C.G.G.J. van Steenis (ed.), *Flora Malesiana*. Series 1 Vol. 6. Wolters-Noordhoff Publishing, Groningen. Pp. 293–336.

Merrill, E.D. (1917) Alabastra Borneensia. *J. Straits Branch Roy. Asiat. Soc.* 77: 231–237.

Merrill, E.D. (1952) William Jack's genera and species of Malaysian plants. *J. Arnold Arbor.* 33 (3): 199–250.

Miquel, F.A.W. (1857) *Flora van Nederlandsch-Indië*. Vol. 2. Amsterdam, Netherlands.

Putz, F.E. & N.M. Holbrook (1989) Strangler fig rooting habits and nutrient relations in the Llanos of Venezuela. *Amer. J. Bot.* 76 (6): 781–788.

Ridley, H.N. (1908) New and Rare Malayan Plants. *J. Straits Branch Roy. Asiat. Soc.* 50: 117–123.

Ridley, H.N. (1914) On a collection of plants from Gunong Mengkuang Lebah, Selangor. *J. Fed. Mal. St. Mus.* 5: 28–50.

Ridley, H.N. (1923) *The Flora of the Malay Peninsula*. Vol. 2. L. Reeve & Co., London. Pp. 415–422.

Ridley, H.N. (1925) *The Flora of the Malay Peninsula*. Vol. 5. L. Reeve & Co., London. P. 322.

Ridley, H.N. (1930) *The Dispersal of Plants Throughout the World*. Reeve & Co. Ashford, Kent, England. 744 p.

Roxburgh, W. (1824) *Flora Indica or Descriptions of Indian Plants*. Vol. 2. Mission Press, Serampore. Pp. 31–37.

Struwe, L., J. Kadereit, J. Klackenberg, S. Nilsson, M. Thiv, K.B. von Hagen & V.A. Albert (2002) Systematics, character evolution and biogeography of Gentianaceae, including a new tribal and subtribal classification. In: L. Struwe & V.A. Albert (eds.), *Gentianaceae–systematics and natural history*. Cambridge University Press, Cambridge, U.K. Pp. 21–309.

Sugumaran, M. & K.M. Wong (2012) Studies in Malesian Gentianaceae, I. *Fagraea* sensu lato–complex genus or several genera? A molecular phylogenetic study. *Gard. Bull. Singapore* 64(2): 301–332.

Sugumaran, M. & K.M. Wong (2014) Studies in Malesian Gentianaceae, VI. A revision of *Utania* in the Malay Peninsula with two new species. *Pl. Ecol. Evol.* 147(2): 213–223.

Thunberg, C.P. (1782) Beskrifning pa et nytt och vackert orte Genus, Kalladt *Fagraea ceilanica*. *Kongl. Vetenskamps Acad.* nya Handlingar Stockh. 3: 132-134, tab. IV.

Wong, K.M. & J.B. Sugau (1996) A revision of *Fagraea* (Loganiaceae) in Borneo, with notes on related Malesian species and 21 new species. *Sandakania* 8: 1–93.

Wong, K.M. (2012) Studies in Malesian Gentianaceae, IV. A revision of *Picrophloeus*. *Gard. Bull. Singapore* 64(2): 511–522.

Wong, K.M. & M. Sugumaran (2012a) Studies in Malesian Gentianaceae, II. A taxonomic framework for the *Fagraea* complex, including the new genus *Limahlania*. *Gard. Bull. Singapore* 64(2): 481–495.

Wong, K.M. & M. Sugumaran (2012b) Studies in Malesian Gentianaceae, III. *Cyrtophyllum* reapplied to the *Fagraea fragrans* alliance. *Gard. Bull. Singapore* 64(2): 497–510.

Yeo, C.K., B.Y.Q. Ng, P.X. Ng. K.Y. Chong, A.F.S.L. Lok, W.F. Ang, S.Y. Tan & H.T.W. Tan (2011) Air-layering: A suitable method for mass-propagating the nationally critically endangered *Fagraea auriculatum* Jack (Gentianaceae). *Nature in Singapore* 4: 383–392.

Zimmerman, J. (1932) Über die extrafloralen nektarien der Angiospermen. *Bot. Cent. Beih.* 49: 99–196.

INDEX TO COLLECTIONS

The numbers following each herbarium specimen (generally listed by collector name and number) refer to the following taxa:
1. *Fagraea auriculata* Jack; **2.** *Fagraea cameronensis* K.M.Wong & M.Sugumaran; **3.** *Fagraea carnosa* Jack; **4.** *Fagraea crassifolia* Blume; **5a.** *Fagraea curtisii* King & Gamble var. *curtisii*; **5b.** *Fagraea curtisii* var. *calcarea* (M.R.Hend.) K.M.Wong & M.Sugumaran; **6.** *Fagraea fastigiata* Blume; **7.** *Fagraea fraserensis* K.M.Wong & M.Sugumaran; **8.** *Fagraea gardenioides* Ridl.; **9.** *Fagraea imperialis* Miq.; **10.** *Fagraea kinghamii* K.M.Wong & M.Sugumaran; **11.** *Fagraea larutensis* M.Sugumaran; **12.** *Fagraea latibracteata* M.Sugumaran; **13.** *Fagraea littoralis* Blume; **14.** *Fagraea oblonga* King & Gamble; **15.**

Fagraea renae K.M.Wong & Sugau; **16.** *Fagraea ridleyi* King & Gamble; **17.** *Fagraea splendens* Blume; **18.** *Fagraea tubulosa* Blume.

Ahmad AS 119: **1** — Allen KEP 79285: **17;** Allen s.n. 27 i 1957: **3** — Alvins 179: **17**; 2053: **1**.

Bland s.n. 24 viii 1902: **1** — Blume s.n. no date (L: acc no. 908127-530): **13**, s.n. no date (L: acc. no. 908127-615 & barcode L0005079): **18**, s.n. no date (L: acc. no. 908127-626 & barcode L0005080): **18** — Boey 298**: 5b**, 398: **1**, 421: **1**, 422: **3**, 528: **5a** — Burkill HMB 818: **2** — Burkill & Haniff SFN 12585: **11**, SFN 12643: **10**, SFN 12685: **14**, SFN 12861: **10**, SFN 12982: **14** — Burkill & Holttum SFN 7861: **14** — Burkill, Shah & Noor HMB 2384: **8**, HMB 2421: **14** — Burn-Murdoch 117: **17** — Buwalda 6774: **1**.

Carrick 659: **1** — CF 908 (Collector name indistinct): **9** — Chan FRI 19905: **17**, FRI 25183: **3** — Chelliah FRI 6513: **17** — Chia & Chin LT 372: **5a** — Chin 367: **3**, 566: **3**, 569: **15**, 910: **5a**, 967: **5a**, 1151: **3**, 1524**: 5b** — Chua et al. FRI 40798: **8** — Cockburn FRI 7121: **6**, FRI 7252: **12**, FRI 8026: **16**, FRI 8279: **12** — Corner SFN 38129: **5a**; Corner s.n. 15 v 1935 (SING): **17**, s.n. 22 vi 1934: **1** — Curtis 346: **17**, 1676: **5a**, 1696: **5a**, 2356: **17**, 3013: **17**, 3394: **3**; Curtis s.n. ii 1900: **3**, s.n. vi 1890 (SING): **17**.

Damahuri FRI 36505: **14** — Derry 1218: **1** — deWilde & deWilde-Duyfjes 14047: **9**.

Forsten s.n. no date (L: acc. no. 908127-228): **13** — Fox s.n. x 1899 (SING): **10** — Foxworthy CF 1726: **1**.

Gadoh KL no. 1592: **15**, KL no. 2167: **17**, KL no. 2215: **17** — Garcia FRI 32703: **10** — Griffith 3737: **4**; Griffith s.n. 1845: **1**.

Hairul FRI 72264: **14** — Haniff SFN 3755: **17**, SFN 15584: **5a** — Haniff & Nur SFN 2344: **10**, SFN 7089: **5a**; Haniff & Nur s.n. 12 xii 1918: **1** — Hashim KEP 1084: **14** — Hasselt s.n., FB, no date (L: acc. no. 908127-218 & barcode L0005009): **6** — Heaslett 7: **17** — Henderson SFN 1381: **16**, SFN 10490: **1**, SFN 11128: **14**, SFN 11673: **3**, SFN 11805: **10**, SFN 11807: **11**, SFN 11838: **14**, SFN 17729: **3**, SFN 21412: **17**, SFN 23289: **10**, SFN 25036**: 5b**, SFN 29109: **5a**, SFN 32967: **14**, SFN 36671: **17**; Henderson s.n. 19 viii 1929: **1**, s.n. 6 x 1931: **3** — Hislop s.n. vii 1952 (SING): **10** — Hullett 164: **1**; Hullett s.n. 23 vii 1893 (SING): **16**.

Imin FRI 63057: **14**, FRI 66475: **8**, FRI 68437: **5a**.

Jaamat KEP 27295: **10** — Jaamat & Lasah FMS 27672: **4** — Johnson AJ 4036: **1**.

Keng, Wee & Honours students T3/48: **17** — Kerr 7778: **17**, 13674: **17**, 15962: **1**, 16603: **1**, 16775: **17**, 18837: **1**, 18837A: **17** — Kiah & Henderson SFN 37739: **17** — Kiew 1485: **9**, 3320: **7** — King's Coll. 3868: **15**, 4238: **15**, 4878: **17**, 5430: **14**, 6162: **17**, 7518: **11**, 10124: **15**, 10634: **17** — Kochummen FRI 16514: **14**, FRI 19451: **14**, KEP 98161: **10** — Korthals s.n. no date (L: acc. no. 908127-518 & barcode L0004986): **17**, s.n. no date (L: acc. no. 908127-639 & barcode L0004984): **17**.

Lim FRI 56592: **14** — Lim SING 2011-285: **1** — Loh FRI 19156: **14** — Low LYW 138: **2**, LYW 227: **16**.

Machado s.n. 13 v 1903 (SING): **16** — Mahmud s.n. iv 1970 (KLU): **14**, s.n. vii 1970: **1**,

s.n. v 1972 (KLU): **15** — Maingay 1025: **1** — Manurung 27: **14** — Medan KEP 45409: **3** — Mohamad KEP 14972: **17** — Moysey & Kiah SFN 31081: **10**.

Ng FRI 1373: **15**, FRI 1627: **3**, FRI 5563: **9**, FRI 5930: **2**, FRI 27054: **9** — Ng & Beltran FRI 6389: **17** — Ngadiman SFN 36752: **1** — Nur SFN 11288: **3**, SFN 18191: **16**, SFN 32967: **14**.

Perumal et al. FRI 41624: **10** — Poore 749: **8** — Purseglove P 4141: **14**, P 4231: **8**.

Quaife s.n. x 1940 (SING): **14**.

Rabil 276: **5a** — Rahim KEP 97950: **1** — Ratnasabapathy s.n. 26 v 1974: **1** — Ridley 2170: **1**, 2767: **16**, 3182: **17**, 3785: **16**, 5558: **14**, 5845: **16**, 6312: **17**, 7551: **13**, 7607: **15**, 7998: **1**, 9157: **13**, 9582: **1**, 9738: **18**, 10297: **3**, 11363: **16**, 11639: **1**, 12069: **14**, 13838: **14**; Ridley (no. indistinct) 12 viii 1889 (SING): **16**; Ridley s.n. vi 1890 (SING): **17**, s.n. iii 1892 (SING): **14**, s.n. viii 1899 (SING: barcode SING0011372): **16** — Robinson s.n. 22 i 1913: **8** — Rostado s.n. ii 1904: **3**.

Samsuri SA 315: **17**, SA 915: **1** — Samsuri & Ahmad SA 516: **15** — Samsuri & Mahmud SA 628: **5a** — Sang JS 67: **15** — Saw FRI 34065: **15**, FRI 44801: **12** — Scortechini 817: **15**; Scortechini s.n. 21 vi 1909: **14** — Shah MS 2730: **14** — Shah & Ahmad MS 3408: **17** — Shah & Ali MS 2855**: 5b** — Shah & Sidek MS 4045: **1** — Shah & Tan MS 5051: **17** — Sidek S 282: **3**, SK 438: **11** — Siew 144: **8** — Sim B-112: **5a** — Sinclair SFN 10608: **17**, SFN 38900: **1**, SFN 40176: **16**; Sinclair s.n. 26 iii 1951: **1**, s.n. 27 i 1957: **3** — Sinclair & Kiah SFN 38660: **11**, SFN 39931: **12** — Soepadmo HUM 9002: **8**, KLU 9103: **1** — Sow KEP 48648: **6** — Sow & Tachun KEP 35092: **3** — Spare F952: **4**, SFN 36006: **13**, SFN 36007: **1** — Steenis 6583a: **9** — Stone 5915: **1**, 7251: **8**, 11079: **3**, 14071: **8**, 14110: **1**, 14616: **17**, 15168: **15**, 15938: **17** — Stone, Mahmud & students BCS 10804: **14** — Strugnell & Tachun KEP 45890: **8** — Sugumaran SM 4: **14**, SM 13: **1**, SM 25: **1**, SM 28: **1**, SM 38: **17**, SM 79: **7**, SM 208: **17**, SM 217: **1** — Sugumaran & Lee SM 175: **14**, SM 176: **14**, SM 186: **3** — Sugumaran & Low SM 163: **7** — Sugumaran & Vijayandra SM 98: **15**, SM 167: **17** — Sugumaran & Wong SM 55: **12** — Sugumaran et al. SM 26: **15**, SM 164: **7**, SM 165: **14**, SM 177: **15**, SM 230: **9** — Symington FMS 28571: **9**, KEP 29482: **8**, KEP 30843: **8**, KEP 32235: **8**, KEP 36092: **10**, KEP 56665: **8** — Symington & Kiah SFN 28923: **15**.

Tan FRI 81814: **5a** — Teo & Wintz KL no. 4819: **5b** — Teruya 229: **1**, 2421: **9** — Teysmann HB599: **9**, HB998: **3**.

Wallich s.n. 1822 (barcode BM001014285): **1** — Whitmore FRI 730: **15**, FRI 963: **9**, FRI 3009: **3**, FRI 3328: **10**, FRI 4164: **9**, FRI 4243**: 5b**, FRI 4386: **6**, FRI 4661: **15**, FRI 12214: **10**, FRI 12518: **3**, FRI 12610: **15**, FRI 15103: **5a**, FRI 15551: **10**, FRI 15697: **15**, FRI 20117: **14** — Wong FRI 32191: **16** — Wray 1992: **15**, 2115: **17**, 2248: **13**, 2714: **13**, 2992: **14**, 3075: **17**, 3202: **4**, 4181: **17**, 4269: **13**; Wray s.n., 1889 (SING): **14** — Wyatt-Smith KEP 85211: **3**.

Yao FRI 53078: **3** — Yeob CF 5849: **4**.

Zahid et al. ZMS 42: **17**.

sine coll. no date (L: acc. no. 908127-756 & barcode L0004983): **4**.